University of Alberta

A Narrative Inquiry into the Reflective Experiences of Children, a Homeroom Teacher, and a Researcher Working with Science, Technology, and Society (STS) Moral Issues in an Elementary Classroom

By

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CHAPTER I

Introduction

The development of science and technology has been an ongoing process throughout our human history. Modern science and technology have brought human beings a wide variety of quality goods and services and higher living standards. Many innocuous products and services such as towels, clothing, furniture, and hot water in our homes are part of the benefits brought by modern science and technology. On the other side, it is also true that people have consciously and unconsciously developed and misused the findings and the products of science and technology. Prehistoric people, for example, invented beautiful stoneware and simultaneously invented swords out of stone and used them during tribal warfare. The misuse of science and technology has been applicable to many results of science and technology. The unique difference in our technological society, as Kirman (1997) pointed out, is that "today, more than ever before, the impact of science and technology on humanity is both pervasive and powerful" (p. 171). During the Second World War, roughly 61 million military and civilian people were killed directly due to the war (Stokes, 1995). Such a massive disaster would not have been possible without the tools of science and technology. Today, science and technology are becoming so powerful and complex in every facet of our daily lives that, I believe, the misuse of science and technology can be detrimental to all of humanity if they are not properly situated in the hands of responsible human beings.

How do we, educators, enable our children to be socially responsible citizens who promote the positive use of science and technology? This study argues that the question cannot be answered in a simple way based on some basic assumptions that are further explained in detail later. First, the issues of science and technology are not simple technical issues but complex moral issues embedded in people's personal, social, and historical contexts. Thus, solving STS[1] issues depends on the individual's moral capacity to cope with one's existential conditions of science and technology. Second, today's STS issues are, more than ever before, complex, dynamic, powerful, and global combined with capitalism, nationalism, techno-science, and globalization. Thus, STS education should be addressed in this broadened contextual understanding of science and technology rather than in a narrow subject-centred curriculum. Third, the dynamics of the misuse of science and technology are deeply related to the negative aspects of capitalism and community values[2] such as nationalism, religion, racism, and interest group. Thus, capitalist and community values in STS education should be addressed based on humanistic values such as human dignity, dialogue, and respect and caring (for the self, others, and nature) which are essential values to living harmoniously with others as global citizens in the age of technology and globalization.

Whether a student or a teacher, we are all humans who construct our moral selves by interacting with our existential conditions, and constructing one's moral selves ultimately depends on an individual's conscious effort and responsibility to know and transform one's moral selves and one's existential conditions. Thus, reflection in this study is reconceptualized as an individual's existential capacity with which an individual knows and transforms one's moral selves and one's existential conditions. Reflection in this study also includes emotional, aesthetic, volitional, and rational dimensions, and these dimensions are all understood as inseparable part of reflective capacity.

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[1] STS is an abbreviated term of Science-Technology-Society.

[2] According to Noddings (2002), community values refer to the values of any specific group or community. She sees nationalism, religion, and racism as community values.

Based on the above assumptions, this study suggests the need of a reflective approach as a way of teaching STS issues in elementary schools. The reflective approach was composed of three different experiences based on the negotiation and cooperation of a homeroom teacher and the researcher: experiences directed related to children's daily lives, experiences indirectly related to children's daily lives, and experiences related to reflective environment. Thus, the homeroom teacher and I tried to provide a variety of reflective spaces in which children actively and freely 1) made sense of STS issues, 2) created their moral decisions, and 3) took their moral actions based on their own personality, capacity, interest, and social setting. The value criteria of the reflective approach was based on humanistic values such as human dignity, dialogue, and respect and caring (for the self, others, and nature).

Narrative inquiry was chosen as the research method to understand the reflective experiences of all the participants: 5th grade children, their homeroom teacher, and the researcher in a Korean classroom setting based on two main beliefs. First was the ontological belief that the reflective experiences of all the participants are a larger shared storied life. Second was the epistemological belief that the reflective experiences of all the participants can be best understood by exploring their storied lives. This study was carried out in collaboration with an elementary homeroom teacher with whom I shared an agenda, purposes, curriculum planning and organization, evaluation, and interpretation while the teacher was solely responsible for the lesson implementation.

Purposes of the Study

The purposes of this study were threefold. First was to explore the reflective experiences of 5th grade children as they worked on STS reflective activities from their homeroom teacher. The second was to explore the reflective experiences of the homeroom teacher and the researcher as we worked on STS reflective activities with children. The third was to explore how 5th grade children cope with their existential conditions of science and technology. The third purpose, however, developed in the middle of this study as the homeroom teacher and I became interested in how each child would cope with STS issues in everyday life.

Research Questions

For the first purpose of this study, the questions were:

1. What are the elementary children's experiences while working on science, technology, and society (STS) moral issues through reflective activities?
2. What stories do the elementary children tell while working on science, technology, and society (STS) moral issues through reflective activities?
3. What influence, if any, does the study have on the elementary children while working on science, technology, and society (STS) moral issues through reflective activities?

For the second purpose of this study, the questions were:

1. What are our collaborative experiences while working on science, technology, and society (STS) moral issues through reflective activities?

2. What stories do we tell while working on science, technology, and society (STS) moral issues through reflective activities?
3. What influence, if any, does the study have on us while working on science, technology, and society (STS) moral issues through reflective activities?

For the third purpose of this study, the questions were:

1. How do the elementary children cope with their existential conditions of science and technology?
2. What does technology mean to the elementary children's lives?
3. What stories do the elementary children tell about technology in their daily lives?

Definitions of the Terminologies

1. Existential conditions of science and technology:

This study is based on existentialist philosophy which stresses an individual in one's setting in the world as the fundamental starting point of philosophic inquiry (Vesey & Foukes, 1990). While existentialist thinkers take very different views of many problems, what unites them is a concern with an individual as a sentient being living and struggling in the world (Vesey & Foukes, 1990). In this study, accordingly, science or technology is understood as a multifaceted entity which includes activities, a body of knowledge, structure, and the act of structuring (Franklin, 1992) affecting an individual's life experience as a concrete event that has been lived through. As a result, this study sees that science or technology does not exist as static or independent concept detached from concrete human experience but exists as inseparable part of the existential conditions such as people, activities, knowledge, structure and the act of structuring with which an individual interacts to cope with one's life.

2. Ontological and epistemological inquiry:

   Ontology, a synonym of metaphysics, is the study of the nature of reality (Audi, 1999). Epistemology is the study of the nature of knowledge and justification (Audi, 1999). In terms of ontological inquiry, this study is a process of knowing the nature of a larger storied life of all the participants: children, their homeroom teacher, and the researcher. In terms of epistemological inquiry, this study is a process of knowing the nature of how we know the nature of the larger storied life of all the participants. In this study, both of the ontological and epistemological experiences were generated, analyzed, and interpreted based on the existential life meanings of our collaborative narrative experiences as a teacher and as a researcher.

Significance of the Study

Curriculum Perspective

Most of the field research on STS education has been done in the area of science education. Influenced by the narrow subject based curriculum (Yager, 1995) and the misconception of science (Osborne, 2000), science educators have difficulty including STS issues in the science curriculum. For example, the majority of the research tends to emphasize the impact of science and technology on society rather than the impact of society on science and technology. Based on the belief that society is the fundamental cause of the misuse of science and technology, this study provided children with STS reflective activities so that they could know and transform their moral selves and their existential conditions of science and technology by practicing reflection and action. Even if STS issues are clearly moral and social issues, I have not found any distinct social studies curriculum or any meaningful claims of social studies or moral educators which are different from the ones of science educators on the issue of the inclusion of STS issues in the social studies curriculum. Besides, I have found no research conducted with a reflective approach in the area of elementary STS research studies. Therefore, it is intended that this study will provide readers with an opportunity to consider the possibility of a reflective approach as another perspective of teaching STS issues in an elementary school setting.

Teaching Method

In terms of traditional STS education, teaching and learning STS issues generally require both teachers and students to have a profound knowledge of science and technology and higher-order-thinking skills. These aspects make it difficult to teach STS issues in an elementary school setting. However, the reflective approach allows a teacher to deal with STS issues without the strong background of science and technology. First, based on children's daily experiences, the reflective approach allows children to reflect upon their daily STS issues freely through the use of observation, conversation, journal writing, and children's newspaper. Second, the reflective approach allows teachers to guide children's reflection easily through conversation, feedback, discussion, and storybooks. Third, the reflective approach can be easily used in many subject areas such as moral education, social studies, science, language arts, art, English, practical practices, computer, and teacher's discretional lessons (TDL)[3] because of the omnipresent topics for reflection and STS issues in children's daily lives. Therefore, it is intended that this study provides readers with an opportunity to consider a variety of activity choices for teaching STS issues in an elementary school setting.

Moral Education in Korea

As a curriculum subject, moral education in Korea has traditionally focused on character education. Character education once played an effective role as the value transmitter of Korean culture and national values. However, as society becomes increasingly complex, so do children's moral lives. Character education in Korea may be reconsidered in that today's fast growing technological world makes it even more important than ever for teachers to grow and strengthen children's existential moral capacity by which children autonomously make sense of their powerful STS existential conditions, create right moral decisions, and take right actions in their daily lives. Because the whole learning process of the reflective approach is based on children's own conscious moral construction, especially, of their daily lives, it is intended that this study provides the readers with an opportunity to reconsider the scope, content, and teaching strategies of moral education as a curriculum subject in Korea.

STS Issues in Children's Lives

Korea, a once poor country after the Korean War in 1950s, has now become a fully industrialized country and is a highly competitive scientific and technological nation. Korean society is also a very dense and compact society because the size of Korea is less than 1/6 of Alberta, but the population is over 43 million. Owing to the lack of natural resources, the growth of Korea depends on human resources, particularly, the people in the community of science, technology, and business. From my experiences and observations as a teacher, father, and member of Korean society, a variety of technologies are exposed to children in their daily lives. It is now common for children in Korea to carry camera phones, and almost every home is provided with high speed Internet service. However, when I examine our society more closely, I cannot dare to say that I live in a better world than before because of economic disparity, air and water pollution, contaminated foods, and excessive stress and competition due to people's misuse of science and technology. For example, in major cities in Korea, it is often hard to breathe in air and to see the clear blue sky because of the polluted air.

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[3] In Korea, there are a few subject areas not appearing in the Canadian elementary school curriculum. Moral education teaches the core moral values of Korean culture. Practical practices teaches skills such as planting, cooking, clothing, and how to handle electrical devices. Teacher's discretional lessons (TDL) are organized based on a homeroom teacher's wish, need, or specialty.

In terms of children, they have less opportunity to walk and play on soil in city settings. Most of Korean children are busy with many kinds of extra learning activities. Their parents are busy with working outside, and many of them come home late in the evening or at night from their worksites. A crowded PC room or game room often filled with adults' smoking is the most popular place our children enjoy in the middle of their hectic lives going from one study place to another. At night, they are busy with on-line chatting, or they are easily exposed to all kinds of immoral virtual places. Korean children do not have the opportunity to spend much time with their family members, especially their fathers, who usually work late at night in their workplaces. Thus, there are many aspects of children's existential conditions of science and technology affecting children's lives directly or indirectly in Korea. Therefore, it is intended that the study provides readers with in-depth narrative analysis on how a small group of children in Korea cope with their existential conditions of science and technology in their daily life.

Teacher Education

Connelly and Clandinin (1988) emphasized the teacher's personal practical knowledge by saying, "the teacher is the most important agent after the students, of course, in a curriculum situation from the point of its planning and development" (p. 13). No matter how useful the curriculum may be, we cannot say that it is of use unless it becomes meaningful to a teacher's life. For example, homeroom teachers in Korea are provided with a fully equipped technological classroom as well as teaching materials. However, teachers often say that they struggle with their teacher identities as a teacher of students and as a teacher in school landscape. In the pilot study, my cooperating teacher, Nara (pseudonym), provided some reasons such as fixed curriculum, test-oriented teaching environment, and excessive managerial work and school activities. It is more likely that teaching becomes more powerful and meaningful when a teacher's philosophy and ideas about teaching are interwoven into the curriculum. Therefore, it is intended that a collaborative meaning-making study of a teacher and a researcher will provide the readers with some insights into how Korean in-service teacher education could be reconsidered.

Audience and Composition of Research Text

The goal of this study was not to test the effectiveness of a reflective approach with a purpose of generalization but to understand the reflective experiences of all the participants shared in a space of STS reflective activities with a view of cycling the shared understanding at a particular moment in our continuous journey of becoming better teachers. Thus, the storied accounts in this study are unique to the participants at the time in a Korean context. However, irrespective of the tradition, almost all educational research is concerned about transferability in one way or another. As Lincoln and Guba (1986) described, "fittingness…defined as the degree of congruence between sending and receiving contexts" (p. 124), the researcher's responsibility as the narrator is to provide the readers with a rich and faithful storied account so that they can compare the degree of similarity between the study site and the receiving context.

This is the reason I have struggled more with the tensions and concerns of composing a research text particularly on behalf of the audience in other cultures because morality as well as the degree of significance in morality are different from one culture to another. Particularly, the two main concerns were 1) that the readers may understand the narratives somewhat differently due to the lack of understanding of Korean culture and 2) that the readers may understand the narratives somewhat differently due to the English translation of Korean language. To reduce the misunderstandings of the audience, I composed the research text based on a few ideas. First, to reduce the misunderstandings of Korean culture, I provided the audience with explanatory words, phrases, stories, and drawings when I found a need to help the audience. Second, to reduce the misunderstandings of the English translation of Korean language, I provided the audience with explanatory words and phrases by using brackets, parentheses, and footnotes. It must be noted that I tried to create a word to word translation from Korean to English so that the readers would not lose the unique meanings of each word, especially, children's words in journals, poems, and letters based on my belief that children's words have unique meanings and those meanings sometimes may not be successfully communicated to, or felt by, the readers in different cultures through the researcher's free translation.

CHAPTER II

Researcher's Journey into Research Topics

STS Issues in Researcher's Life

I was born in 1969 in a city in Korea, but I moved to a very rugged mountainous area just after my birth. My village was on the foot of Palgong Mountain (1192 m). At the time, my father worked as a temporary janitor at the U. S. Air Force radar base on top of Palgong Mountain. He could not find any better job because of his suffering from polio. Before I became a third grader, I had lived in a small cottage made from clay and straw. However, I remember my early elementary years full of happiness. In spring, I played with various kinds of bees, butterflies and wild flowers. I used to go to a nearby mountain with my friends where I used to pick up the petals of azalea to eat them. When I was a first grader, I heard a sad news that a female friend of mine was killed by wolves in a mountain where she picked wild vegetables to eat. In summer, I took my goats to a nearby stream to have them graze the grass. In the meantime, I used to join my male friends and could not wait to jump into a stream. It was always an exciting time that we caught crawfish and minnows in the stream. When bored, we tried to catch all kinds of small animals such as grasshoppers, dragonflies, and frogs on the grass where goats and cows were grazing. One night in late summer, my friends and I sneaked into a fruit farm to steal watermelons, but we were caught sight of by an old man. When I heard a big voice of "wait, you stealers," we had no choice but to run and run until I heard no voice from behind anymore. I could not even look back because of the horror of being caught by the big hand. This kind of children's stealing was so common and culturally acceptable in those times. Traditionally, Korean villages were characterized as an agrarian community based on strong kinship or community bond where people usually helped one another in their busy farming seasons. Some old men even used to welcome the children who tried to steal fruits from their farms and gave them their watermelons which he had already prepared for the expected guests. For the old man, it was a fun way of giving gifts to the children he already knew while it was a way of fun and adventure for the children in those times. Many male Koreans in their middle ages have similar stories to mine, and they cherish the stories because people might not find such kind of belonging and togetherness they once enjoyed any more in today's individualized technological society.

My first conscious meaningful experience with technology happened when I was a first grader. On a bitterly winter day, my father bought a TV which marked the first one in my village. I still remember how much my heart was pounding when I was approaching my cottage house from the school to see the presence of the black and white TV. Because of the nice TV, I became the most noticeable figure at my school for a while. That little technology made our family's small cottage become the center of the village as a sharing place of watching TV. In the evening, women in their middle ages used to come to my house everyday to see TV dramas. It was so weird to the eyes of a first grader to see them smile sometimes, cry sometimes, shout sometimes, and get back to normal again.

My life was just like the ways these women went through. My happy life ended when my mother went away from my family to make money after her decision to separate from my father. It happened when I was a 5th grader. On the day she left us, I looked all over the places in the village to search my mother, but I could not find her. I remember I was hesitantly coming to have the unacceptable sense that she finally left us. An old lady came to me in the afternoon on that day and told me the reasons my mother had to leave us. She told me my mother's message that I should live well and study hard so that she could come back and raise me, my younger brother, and my younger sister after making a lot of money. It was not until I became a university student that our family finally were united. By the time the old lady finally left me, I had to find a safe place to cry. Then, an idea suddenly hit upon me that I should find a kind of memory box of my mother which could help me to catch the feeling of being with my mother. I searched all the corners inside home, but there was no single thing which appeared to be the right one. Upon my reflection, she must have put all of her belongings away in order not to remind us of her presence which could cause painful memory to us. But I finally found the right one. It was my mother's sewing basket full of needlework, pieces of cloth, and threads she used to use for our family. I madly searched for a special place to keep it safe and finally found the right place. It was a cabinet attached to the sewing machine in my house, and I kept it inside the cabinet. I enjoyed my memories of being with my mother with it by crying so many times whenever I needed her. It is not until this moment as I am writing this piece of text that I remember the sewing kit was originally in the cabinet. It seems that I have only carried my only memory that I kept the sewing kit in a safe place.

However, the reality was just the reality I had to overcome to survive. I became a mother simply because I had no mother. I cooked, washed clothes, and fired wood to warm the floor of my house for my family. The old lady was a great help for us. I used to be happy to follow her to the five day village market to buy groceries. She often came to my house to give some side dishes she made and helped organizing things in the kitchen. Several months after my mother left us, my grandmother on my father's side came to my house to care for us.

But she was already in her late 70s at the time, and she was the one whom must be cared for. My younger brother, younger sister, and I had to suffer malnutrition. It was more serious to me, and I suffered from a malignant anaemia whenever I tried to stand up for over a year.

As I became a middle school student, I had to walk about 40 minutes everyday to my middle school, but most of the other friends commuted to the school by bus or bike. My father did not make enough money to buy me a bike or to give me pocket money to use buses. There were a few girls who used to walk to my school, but I had to walk alone because they were all girls. I did not want myself to be made fun of from dating girls by my male peers. However, I always envied my friends who rode their bikes to the school. I felt so ashamed of myself walking on the road while my friends passed by riding their bikes. Their bikes were kinds of jet planes to my imagination. While walking on a very cold day, a friend of mine offered me a ride on the back seat of his bike, but I refused. He kept saying he would take me to the school. I wished to say I would, but I refused again and again. I felt very ashamed and harmed by his offer. I felt that I was treated as a very poor person just like a beggar even if I knew that his offer came from his real heart. On cold and rainy days, I usually became the only person who was walking on the road, and I always had to go through the shameful moment of walking alone when a bus full of my classmates passed by. So, I started to tease my father to buy a bike for me. Considering our family's poor economy, I knew it would cost him a big money at the moment, but I continued to tease him to my last effort. After a month's of struggle, we finally made a deal that he was going to buy me a brand new bike on the condition that I would try my best to raise my academic achievement scores in school.

Finally, the day came! It was on the first day of riding my bike that I felt like I became a pilot. Everyone was around me again to see my brand new bike. By this bike, I finally became a happy person all the time on the way to school, in class, and on the way back home. At night, I tried my best to keep the promise of raising my academic achievement scores in school. At last, I was successful in achieving an honour reward from the school when I was in 8th grade. It was a real big jump from the bottom to the top. Frankly speaking, it was not until that moment that my academic achievement ranking finally became nearer from the top. My father, then, called my maternal grandmother, his mother-in-law, and reported my improvement. My maternal grandmother was very happy with my effort. After several conversations with my maternal grandmother, my father finally received permission to allow his children to be transferred to the schools in a small city called Miryang where my maternal grandmother lived. My younger brother, younger sister, and I lived in my maternal grandmother's house until I finished my high school. I tried my best to study hard whenever my eyes were open. I only slept about 5 to 6 hours during my high school years. I wanted to make my mother feel happy and proud of her son in the middle of her hard life. I remember how much my mother and my maternal grandmother became so happy when I got an honour from my high school.

My father tried his best to please my mother and became a sanitarian at the U.S. Air Force base in a major city in Korea where he retired in his age of 62. My mother worked in a restaurant where she did all the heavy dishes at the beginning, but, later, she became a cook. However, my father, my mother, and their three children all lived in different places until our family's reunion. My family was united when I entered one of the National Universities of

Education, and my mother kept her promise she had left to me by the lips of the old lady. She made enough money to buy a small house in a major city in Korea when I was admitted to the university, and she assisted all the university tuitions of her three children. The little technology, my bike, which once drove me to the corner of hopelessness, played a successful role of calling all my family members back into a space of shared meaning. Upon my reflection, technology could become such a powerful meaning maker in my life originally because of my father's caring by buying me the bike. His caring was followed by his more sincere caring by asking his mother-in-law to raise us, and it was again followed by much more sincere caring by my mother and maternal grandmother. My family's caring really made a great difference in my life because it enabled me to have capacities to cope with my harsh existential conditions. All of them saw me as a whole person, searched their best parts, and contributed to my growth in the middle of their harsh struggles of living. Without their caring, I may not have overcome my harsh existential conditions successfully.

I raise another point based on my reflection: my socio-historical contexts. I know that the immoral socio-historical structure which prevented my father as a handicapped person from having any better job played a part of my desperate struggle with not having the little technology, the bike, without mentioning our family's struggle. Upon my reflection, I reached a hunch that society is the fundamental cause of the misuse of science and technology and an individual plays the pivotal role of changing the immoral socio-historical structure she or he is situated in. Indeed, as Friere (1971) envisioned, becoming a moral person is a process of knowing and transforming the self, the reality, and the world.

Reflection in Researcher's Life

When I look back into the history of myself, I feel sorrow reflecting upon aspects of my life struggling with disconnected multiple selves as human, teacher, husband, father, and son of my parents. As other Koreans did, I ran into the future as hard as I could, but I could not find much meaning in my busy life. In my early elementary age, I learned the story of 'An Ant and A Grasshopper' in which a grasshopper was described as a lazy character that always searches for fun while an ant works so hard during the hot summer. When winter comes, the grasshopper finally becomes a beggar in front of the ant's house. My former homeroom teacher taught us that we should live the life of the ant and prepare for the future as 'hard' as we could. I remember that 'study hard,' 'work hard,' and 'live hard' have been the most frequently used encouragements made by teachers for their students in Korean classroom. I believe that this spirit of 'doing hard' came from Korean people's desperate efforts under a strong governmental direction to free ourselves from hunger after the Korean War which drove our country into ruins in 1950s. This is the reason Koreans sometimes call this spirit 'hunger spirit,' and this spirit helped lead us to 'the economic miracle in Korea.' As my former teacher taught me, I studied hard and worked hard. But I could not help but ask myself, "Why do I have to live a wanderer's life outside of my life and continue to have constant tensions between a teacher of my students and a teacher in my professional landscape. This is why I have tried avoiding saying 'study hard' or 'live hard' as often as I can since ten years ago. For what I should live hard? Who is ultimately responsible for the construction of the 'what'? Are they teachers or students themselves?

Upon my reflection, it was my constant reflection on my life which enabled me to define the 'what,' which finally led me to construct my own consciousness of who I am in various relational contexts I was situated. As Kerby (1991) explained that "consciousness is related to and caught up in a present of things past and a present of things to come" (p. 84). The present is a moment of connection between the past and the future in which I shape and reshape a narrative unity (Connelly and Clandinin, 1988) of who I am by overcoming the disconnected multiple selves. Working hard does not necessarily mean that a person lives meaningfully. The feeling of living my life as an outsider… I would say that the feeling was just like several independent selves in me were trying to pursue different goals, without meaningful dialogue among them. My struggle particularly came from the tension between the teacher identity of my students and the teacher identity in my school landscape. I had to struggle with fixed school curriculum, excessive managerial work, pressure for promotion, hierarchical structure, and achievement based evaluation. I worked for two private elementary schools for five years in Korea: one for two years, one for three years. I remember I overworked myself and became hospitalized when I was a teacher at the first private elementary school because of my failure to adapt to the entrepreneurial culture of the school even if I taught my students as hard as I could. I remember my colleagues and I usually got together at night after work to console each other struggling with the strong hierarchical pressure of the second private school. The hardship lasted long and prevented me from having an opportunity to reflect on my family as well as my life. Memories of spending minimal time with my family and not being able to care for them as much as I would like, left me a strong feeling of guilt.

However, the worst crisis I have ever met as a teacher came when I was transferred to a public school where I was in charge of after school extracurricular activity. It was the first experience of my whole nine years of elementary teaching career that I felt almost always short of time to teach even during the normal class hours. The quantity of the work was just huge. First, I had to develop an after school curriculum after I started my new academic year in my public school. Second, I had to look for the instructors of after school class from outside of my school. Third, I had to develop and analyze several questionnaires for students and parents in a year. Fourth, I was in charge of buying and preparing for children's learning materials, making enrolment checklist, and paying for the instructors despite the presence of several office workers in the managerial office. Sixth, I sometimes had to report, what teachers call, 'emergent official documents' that had to be sent to the regional educational office by the exact time they set. I could hardly name all the managerial work I worked with. The pages of my official documents in my file folder were well over 500 within 40 days. It was a painful moment when I saw my students waiting for my caring. I felt I was completely caught by the tension between the teacher identity of my students and the one in my school landscape. I could not help but miss the time I had taught my former children at the private schools where I, at least, could teach children at my best. Korean public classroom is filled with advanced technology such as a wide screen TV, computer, beam projector, overhead projector, home theatre system, and various audio-visual teaching resources. But what I really needed was enough time to care for my children rather than those technologies. The struggles I had had as a teacher in Korea made me decide to start my Ph. D. study at the University of Alberta in Canada. So, our family packed our stuff and left Korea for a new life in a foreign landscape. Frankly speaking, I was happy most simply because I was lucky enough to escape from the terrible moment of being a teacher at a public elementary school even if leaving my beloved parents was a difficult moment.

Our department at the University of Alberta is well known for its qualitative research traditions. In most of the classes, readings, and seminars, words such as 'reflection,' 'genuine engagement,' 'love,' 'wholeness,' 'relation,' 'caring,' and 'personal experience' frequently led me to reflect on the question 'Who am I?' as educator, husband, and father. I came to know that overcoming the conflicts of different selves was possible through my reflection by which I shape my wholeness in relation to each part. One example might be 'Can you talk about caring for children without caring for your family?' Constant reflection on the question 'Who am I?' provided time and space to connect these conflicting multiple selves into a unity. By reflection and action, I began to recover from a deep inner turbulence I had brought with me for most of my life. I felt that my research work empowered me to continue to learn and construct my wholeness through reflection. Reflection in turn provided time and space to connect my disconnected themes of my research. Reflections in my life and in my research were inseparably related and happened interchangeably. Thus, my research work was not just a piece of my academic work to be completed as a component of my doctoral studies; it was a part of my life. Indeed, reflection was a powerful moral capacity in my life which enabled me to construct my meaningful moral selves in relation to others.

CHAPTER III

Rethinking STS Education

Introduction

STS education is an educational endeavour to educate responsible citizens who promote the positive use of science and technology in a society (Yager & Tamir, 1993; Waks, 1992), and it presupposes that understanding STS issues and its educational endeavour are social and ethical matters. Thus, the interpretation of social and ethical issues embedded in the relationship between science, technology, and society is a necessary condition for determining how to teach STS issues in schools. However, the problem lies upon the question of 'how should we define or understand people (the self and others), context (personal-social, historical, and nature), and issues of their interactions?' Since STS issues and schooling are both a part of complex and dynamic socio-historical phenomena, this study begins a discourse of understanding STS phenomena with a socio-historical perspective. Therefore, this chapter, first, generates an interpretive paradigm in understanding the social and ethical issues of STS phenomena partly by clarifying the value influences between science, technology, and society and partly by explaining the dynamics of the misuse of science and technology. Second, this chapter, based on the interpretive paradigm, shows some challenging issues of current STS education and the need of a paradigmatic shift from science-technology based approach to a more society based approach.

STS Studies and Its Implications for STS Education

STS studies are composed of a wide range of ethical issues regarding science and technology from various academic disciplines such as philosophy, social sciences, science, engineering, art, religion, and education. STS studies became an important agenda in academia after people observed the uncertainty of science's autonomy and responsibility during the Second World War (Newton, 1983; Merton, 1977). Science critics have brought up systematic epistemological outlooks on the value-laden aspects of science for several decades (Ziman, 2000; Keller, 2000; Longino; 1990; Proctor, 1988; Gould, 1977; Merton, 1977; Kuhn, 1962). These outlooks have been so influential that many scientists have modified the concept of value-free positivist epistemology and have worked to construct a unified epistemology of science (Sokal, 2003; Ashman, 2001; Sokal, 2001; Park, 2001; Sherman, 1997; Bradie, 1994; Dawkins, 1989; Wilson, 1988). Now, most scientists, in one way or another, agree that personal and social values are inevitably related to their way of knowing and these values may either contribute to scientific inquiry or involve some biases. Ost (1985) explained that "science is the driving force of technology, technology provides the justification for basic science, but both technology and science are restrained by society" (p. 39). As a physicist, Ashman (2001) also agreed that "science is clearly a social activity, and as such it is susceptible to the weaknesses of human individuals and institutions" (p. 117).

How do science, technology, and society influence or shape one another? I suggest three linkages between science and values in clarifying the relationship of science, technology, and society, which, in turn, provides an interpretive paradigm in understanding the current issues facing STS education. The first linkage between science and values is cognitive limitations and preconceived notions in scientific inquiry: intuition, imagination, judgment, wishful thinking, feelings, and prior knowledge. Cudd (2001, pp. 81-84), a philosopher of science, stressed that science is practiced by people who bring their prejudices and biases to their pursuits. She warned that because of these prejudices and biases, science can lead to systematic bias and fallibility. However, she insisted that science can be objective if its practitioners seek constantly to uncover cognitive biases—she explained that objectivity in science is never a finished product but a process. She argued that science can be objective partly by the open and fair social practices of science and partly by rigorous process such as controlled experiments and rigorous deductions.

Simpson (1964), a well-known biologist, warned us the danger of oversimplification among scientists. He explained that evolutionary process is ultimately unpredictable because there are innumerable incidental occurrences of past and present micro-scale configurations, and, thus, theoretical representations of all these occurrences can only be represented probabilistically, not deterministically. Although Simpson actively engaged in explaining his belief in evolution, he expressed his opinions on the origin of nature based on proven evidence while leaving unproved hypothesis a possibility or probability level. Simpson (1964) said:

> The very beginnings of life are not known in the record and in the nature of things could not be adequately recorded, if at all. Studies on other bases demonstrate not only the possibility but also the probability that life arose from the inorganic spontaneously, that is, without supernatural intervention and by the operation of material process, themselves of unknown origin (p. 341).

From my point of view, Simpson is a good model of how scientists should be. Simpson's interpretation does not extend beyond the evidential boundary, but, rather, he recognizes the limitations of human cognition and scientific reductionism in scientific inquiry. The limitations of human cognition and scientific reductionism inevitably affect scientific inquiry: assumptions, presuppositions, hypothesis, testing, and interpretation. When there is any cognitive fallacy at any stage of the whole process of scientific inquiry, it can easily lead to biased results.

It is true that many scientists have been consciously engaged in social change based on their scientific beliefs, and some of them were morally wrong such as Dalton and Pearson who led the eugenicist movement[4] on the fear of human or racial degeneration (Bowler, 1933, p. 115). I do not think there is anything wrong for scientists to be actively engaged in social activities based on their scientific beliefs. But the problem was that Dalton and Pearson had wrong assumptions and presuppositions and collected only partial, incorrect data (Shipman, 1994, pp. 107-121; Bowler, 1993, pp. 115-117). Therefore, scientists should pursue every possible cause of difference and communicate with other scientists as well as the people outside of science community not only to avoid any serious bias but also to obtain insights for the social consequences of their inquiry and activity from other disciplines.

The second linkage between science and values comes from the value-ladenness of scientific theory or knowledge. First of all, the limitations of scientific objectivity must be explained in order to understand the value-ladenness of science. Scientific objectivity is the most important standard that differentiates scientific knowledge from other types of knowledge, and the justification of scientific objectivity is possible through external validation and rigorous reasoning (Sherman, 1997; Wilson, 1988). However, Ziman (2000, pp. 321-327), both a scientist and philosopher of science, explained that scientific objectivity has the reductionist view of the world by reducing a phenomenon into a simplified explanatory forms. According to Ziman (2000), reductionism is necessary because reductionism is a useful and inescapable process which makes scientific research feasible. He further explained that "a great many features of the world can be explained by separating a complex entity into simpler constituents or by inferring a general theoretical principle that covers a number of special cases" (p. 322). Nevertheless, Ziman (2000) also explained the limitations of scientific inquiry as follows:

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[4] Eugenics is a concept of science coined by Dalton that would improve the human species by affording the more suitable races or strains of blood, a better chance of prevailing speedily over the less suitable. Pearson pushed the movement further by emphasizing the most important struggle for survival occurred between nations and races rather than between individuals (Shipman, 1994).

> Scientists strongly believe that science is progressing towards producing a complete, comprehensive scientific world picture, which will constitute the ultimate reality. But scientific knowledge excludes many human aspects such as moral, artistic, and aesthetic values, which are just as real as physical data and biological traits (p. 321).

As Longino (1990) explained, reductionism in scientific objectivity has distinct limitations in explaining the world, particularly, the actions of human beings which are related to emotion, aesthetics, intentions, beliefs, and meanings.

Obtaining scientific objectivity does not necessarily prove value-free science. Scientific theory or knowledge is inherently involved in an ethical view in most cases and leads to shaping moral and social values, irrespective of scientific objectivity, the personal ethics of each scientist, or the influence of technology. For example, Simpson (1964), while explaining the forces of evolution, is inevitably engaged in an ethical view on human aims, values, and duties in the light of the nature of human beings and suggests:

> The ethical need is within and peculiar to man, and its fulfillment also lies in man's nature, relative to him and his evolution, not external or unchanging. Man has choice and responsibility, and in this matter, too, he must choose and he cannot place responsibility for rightness and wrongness on God or on nature. These ethics flow from the unique qualities of man and from what is conceived to be his real place in nature (p. 347).

Below is the key summary of Simpson' ethical view on the principles of evolution:

1. Blind faith (unreasoning) is morally wrong, authoritarian or totalitarian because ideology is not based on the qualities of individuality.
2. Valid ethics cannot be absolute because each individual is in the process of evolution.
3. Individual's biological and social variability and flexibility are in themselves desirable, from the point of view of both ethics and evolution.
4. Individual's construction of the world by perception and reason should be respected.

Simpson's ethical views come from his analysis and interpretation of the scientific findings he observed, and his interpretation is inherently value-laden based on his ideas on materialism, individuality, and the dynamics of evolution.

It is also true that even the truest case can lead to shaping an immense moral and social value. For example, today everybody would agree that the earth is round and moves around the sun even if they cannot see this phenomenon through their own eyes. This simple scientific discovery had a huge moral and social impact on society through its long-standing historical debate and contributed to shifting the authority of intelligence from Christianity to science. No matter how much rigorous objectivity scientists may have, they can hardly avoid constructing an ethical view one way or another, and the ethical view leads to shaping moral and social values through the dynamic interrelationships between people and socio-historical contexts.

The third linkage between science and values comes from the close relationship between science and technology. This third linkage is by far the most critical linkage which plays a role of subjugating the two former value linkages to a more vulnerable condition of the misuse of science and technology. Sassower (1997) used the concept of "techno-science" to explain "technical instruments are crucial for theoretical breakthroughs, and a conceptual background is essential for engineering applications, which shows that the work of the techno-scientific community can be characterized as 'a seamless web of connections'" (p. 4).

Historically speaking, the relationship between science and technology was solidified by the impact of scientific power on society after the Second World War (Newton, 1983, pp. 187-188), which, in turn, has been reshaping every aspect of society through capitalist globalization. Now, technology is clearly the dynamic prescriptive entity resulting from powerful social values such as political and economic values. War industry, medicines, communications systems, computer industry, agricultural industry, and genetic engineering are just a part of the whole where social values tend to prescribe, constrain, and confine science in a combined space of techno-science. Thus, scientific activities in the techno-scientific community become generally geared to meet the needs or the directions of government or industry. This fact also suggests that the members of the scientific community are not free from responsibility for their inquiry and activity. For example, Bloche (2003, May 13) explained that although many German industrialists and Nazi doctors were tried and convicted for the misuse of Zyklon B[5], no scientist has ever been convicted of a war crime because of his research that made possible the production of a terrible weapon. He also pointed out that neither transnational law nor the ethics that govern science speaks to the question of researchers' accountability for others' illicit uses of their work. This shows us how much science is susceptible to the powerful political and economic values, and how much the general public are not sensitive to the vulnerability and responsibility of science. There is a similarity between genetic engineering and eugenics on the basis of prescriptive artificial selection. The main difference between these two is their primary inquiry objects: gene or individuality. Keller (2000) warned us that "the invocation of genes have proven demonstrably effective not only in securing funding and promoting research agendas but also in marketing the products of a rapidly expanding biotech industry"(p. 143). Who can deny the possibility that genetic engineering could be tomorrow's Holocaust unless science is not humanly nested in the hands of responsible human beings?

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[5] Zyklon B was developed and used as a chemical weapon by the Nazis for the mass murder during the Second World War. Many Nazi scientists, industrialists, and medical doctors were consciously engaged in developing or misusing Zyklon B (Sassower, 1997; Freedman, 1980)

An important point I raise at this point is that STS educators need to attend to the understanding of social, historical, economical, and political understanding of science and technology which frequently produces and reproduces the misuse of science through technology. In today's technological society, science becomes more restrained and susceptible to the powerful external values such as social, historical, economic, and political values which direct and control scientific goals, activities, findings, and products by controlling funding and job market. We have seen how scientists are susceptible to various cognitive limitations and preconceived notions such as interests and predetermined goals. We have also seen how powerfully scientific knowledge shapes social and moral values. These two former value linkages also become more directed and controlled by the powerful external values, which prevent scientists from doing fair social practices in science. Indeed, solving STS issues and problems does not merely depend on a technical or scientific matter but the individual's existential capacity to know and transform what science is and how science should be in the socio-historical structures science is situated in for human beings and nature. Without knowing and transforming the fundamental dynamics of society, the proliferation of the misuse of science and technology can continue to happen despite our intensive educational efforts as diseases reoccur without curing the original cause.

Dynamics of the Misuse of Science and Technology

Understanding the complex interactions among capitalism, nation-state, techno-science, and globalization is critical to analyzing the forces and the dynamics of the misuse of science and technology in today's world. What is apparent is that the gap between nationalist politics and global economics in the contemporary capitalist world has led nations to depend heavily on science and technology as a power source of international competitiveness in order to survive the harsh capitalist global economy. In particular, countries such as Korea which base their competitiveness on human resources have been exerting considerable efforts to educating more capable scientists and engineers to keep up with the rest of the world.

Negative aspects of capitalism are the most powerful driving force behind the misuse of science and technology which dominates the combined web of capitalism, nation-state, and technology (Burbach, 2001; Franklin, 1992; Adorno, 1973). We need to understand how capitalism has worked and what can be done to redirect the negative aspects of capitalism. Franklin (1992), a Canadian scholar of technology studies, provided an example of the link between capitalism and the misuse of technology:

> In 1851, the mechanical sewing machine became a commercially available device. It was advertised as a household appliance that would free women from chores and drudgery of hand-sewing… The promise was liberation from toil. Not only were individual women to benefit from the new device, but also there were high hopes for humanity as a whole… Reality turned out to be quite different. With the help of the new machines, sewing came to be done in a factory setting, in sweatshops that exploited the labour of women and particularly the labour of women immigrants (pp. 100-101).

Franklin (1992) continued to explain that many of the political and entrepreneurial decisions are related to the advancement of technology and are made on a technical or profitable level, far away from public scrutiny. She stressed that a profound understanding of context including the experiences and views of, what she calls, "the plannees" (p. 83) is required in order to reduce technological disaster.

Consider organ transplants. There is a trade in organs in India, where about 2000 people a year sell one of their two kidneys in order to make money (Jefferis, 1999). Of course, it is true that organ transplants help save many people who are dying without the technology. However, it is also true that selling one of their kidneys only for money is a serious social and ethical problem which was not seriously discussed or predicted before the technology was developed. These seemingly innocuous technologies, sewing machines and organ transplants, have been powerfully misused by the negative aspects of capitalism, and it must be noted that they are merely two examples of the innumerable negative aspects of capitalism.

Another critical point I raise is the power of science and technology which could affect each nation. Each nation still regulates the people within its boundaries, asking its citizens to be loyal and competitive in a highly globalized technological world. Considering the rapidly developing techno-scientific power each nation possesses, it is time for us to think about redirecting the egoistic spirit of nationalism as well as capitalism. How can we allow our children to live in a highly competitive world of nationalism and capitalism with such a huge power of science and technology? Now, the capitalist globalization initiates cultural and political globalization, which frequently brings local problems to international agendas due to both global interdependence and the increased need for the control of techno-scientific proliferation. Without the redirection, who can deny that our future generations may come to rely on the control of an authoritative technocratic world regime envisioned in *1984* by George Orwell? Any forceful ideology should not be allowed to exert domination over the general public. Human beings have already seen a disastrous ideology with the combined power of nationalism, techno-science, capitalism, imperialism, and racism during the Second World War.

It must be noted that although capitalism, religion, nationality, and ethnic characteristics are all part of our essential values and must be respected, we have also seen many occasions of violence brought out by different religions, nations, races, and interests. An example might be the violence of different interest groups hoping to promote their views of abortion, environmental issues, and labour. Today's society characterized by more plural values, globalization, and powerful technology bestows on educators a moral responsibility to enable our children to have moral capacity to live with others. Many scholars, thus, pointed out the importance of educating humanistic values such as human dignity, dialogue, and respect and caring for (the self, others, and the environment) are critical values in the age of globalization (Noddings, 2002, Maughn, 1999; Kirman, 1997; Chodorow, 1981; Friere, 1971).

Background of STS Studies in Education

STS issues in education have been mainstreamed into science education and are composed of a variety of practical studies designed for educating morally responsible citizens of science and technology. Cheek (1997), tracing the history of STS education, outlined the K-12 STS movement in the United States as, "beginning in the sixties and picking up speed in the seventies, spreading from epicentres in private schools in New York City and states like Wisconsin into what has become a mainstream movement in science education and technology education" (p. 3). Cheek emphasized that the focus remained on the importance of science and technology, and for decades, the movement gave less time and emphasis on the relationship among science, technology, and society. STS education now has a stronghold in the science curriculum.

In contrast, STS issues in education have made minimal impact on mainstream social studies curricula. I found neither a distinct STS curriculum nor a systematic movement in the social studies curriculum. There have been several attempts to promote STS education in social studies through the National Council for the Social Studies (NCSS) and Social Science Education Consortium (SSEC) in North America. These efforts, however, have not led to a systematic movement in social studies in terms of the inclusion of STS issues. Marker (1993) presented four possible reasons for the minimal impact of STS education in social studies in the context of the United States:

> 1. The Crowded Curriculum: There is no room in social studies curriculum for yet one more topic, regardless of how worthy it may be. Global education, law-related education, drug and sex education; the list of topics competing for attention in social studies seems endless so STS simply gets lost in the shuffle. (p. 5)
>
> 2. Curriculum Resources: Textbooks determine much of what we do in social studies and current social studies texts do not include much STS contents. Teachers with three or four preparations do not have time to design their own STS modules and are unaware of materials which have been developed by others. (p. 6)
>
> 3. Controversial Topics: Many contemporary STS issues such as genetic engineering, the safety of nuclear power, or holes in the ozone layer are currently areas of public controversy. Why involve students in topics where even the experts

> disagree? Historical STS issues are appropriate for study, but not those embroiled in controversy. (p. 8)
>
> 4. Subject-based Curriculum: Social studies teachers do not feel comfortable dealing with science content and since most STS issues involve some aspect of science, social studies teachers feel it is better to leave them to the science teachers than to 'get in over one's head'. (p. 10)

Marker (1993) contended that "there are the ways around most of barriers, and we need to work around the barriers for the inclusion of formal STS education in national and local social studies curriculum" (p. 12). However, I have not found any distinct meaningful claims of social studies educators which are different from the ones of science educators on the issue of the inclusion of STS issues in the social studies curriculum so far.

Challenges to Current STS Education

Longino (1990), a philosopher of science, explained that "the issue of the interdependence of science and values can be reformulated as two questions" (p. 4). The first question is "to what extent do scientific theories shape moral and social values?" (p. 5). The second question is "to what extent do social and moral values shape scientific theories?" (p. 5). Despite these interactive relationships between science and social values, the majority of the STS studies in education largely focus on the impact of science and technology on society, not the impact of society on science and technology. For example, Waks (1992), an STS educator, stated the goal of STS education as follows:

> STS education situates the learner as a responsible agent, a young citizen, in a society increasingly dominated by the impacts of science and technology. Responsible citizens take responsibility for the impacts of science and technology on society. That is, they increasingly become aware of how science and technology make positive or negative differences in people's lives, and through their thinking and acting attempt to promote the positive and prevent the negative differences (p. 14).

In the above example, Waks focuses more on the question of 'how do science and technology impact on our society?' and elaborates it into the question of 'how do we enable our children to be socially responsible citizens who promote the positive use of science and technology?' On the contrary, this study focuses more on the question of 'how does our society impact on science and technology?' and elaborates it into the question of 'how do we enable our children to be socially responsible citizens who promote the positive use of science and technology?'

Contextual understanding of science, technology, and society and real life contexts have been recently emphasized in current STS studies in education. For example, a well-known STS educator, Yager (2000, 1995, 1993), often expressed his concerns about the lack of broadened contexts in teaching STS in the science curriculum such as the connection between science, technology, and society. Yager (1995) added that "the richness of STS is its larger view of science and its identification of context as vital for real learning to occur" (p. 23). Many current STS research studies (Hogan, 2001; Hollenbeck, 1998; Kortland, 1996), thus, are involved in real life issues. However, the contexts in these studies are used mainly to explore the impact of science and technology on society and tend to be restricted to a specific real life STS issue. From the point of science education, Yager (1995) presented three reasons for this lack of broadened contexts: a) science teachers may find the consideration of technology to be a problem since most of their formal preparation was devoid of any work in technology, b) science teachers find it difficult to start with society and move to technology, and c) even hands-on activities are generally set up to put students through a series of technical manipulations (pp. 31-32). Although efforts to include STS issues in the science curriculum have been a major agenda for science educators (Yager, 2000, 1995; Thier, 1991; Bybee & Bonnstetter, 1987), it is not surprising that science educators have also been struggling with the dilemma of how to fit STS issues into the already overcrowded conventional subject. This phenomenon seems natural because STS issues are clearly social and moral issues and, thus, their curriculum planning and organization should be addressed in a broader educational context rather than in a narrow subject-centred curriculum context.

Osborne (2000) pointed out another difficulty of fitting STS issues into the structures of the science curriculum, and he attributes it to the fact that science education rests on a set of arcane cultural norms. Osborne (2000) provided two distinct areas which illustrate these structural difficulties as follows:

1. Mythical scientific cultural norms:
    a. Too many science courses make students memorize a series of dry facts.
    b. Because scientific knowledge is difficult, learning and understanding science requires a similar process such as higher-order thinking skills.
    c. The science we offer must be both broad and balanced.
    d. Science education persists with presenting an idealized view of science as objective, detached, and value-free.
    e. Science teaches students reflective, critical thinking or logical analysis which may then be applied by them to other subjects of study.
    f. There exists a singular scientific method.
    g. Scientific knowledge has personal utility which is essential to the mastery of technology.
    h. Students are best served by one homogeneous curriculum (pp. 10-12).
2. Practical difficulty:
    a. School science curriculum is a selection mechanism for the few who will become the future scientists of contemporary society.
    b. Society can ill afford the consequent alienation and disengagement with science that science courses generate. (p. 9).

Osborne (2000) explained that misconceptions about how science is done, how science is, and who can participate in science makes it more difficult for STS issues to be properly understood and included in the science curriculum. Thus, it is presumed that the narrow and fragmented dimension of subject-centred curriculum and the misconceptions of science become obstacles in teaching STS issues in schools for both science and social studies educators. Unless there is a profound paradigmatic shift in understanding how STS issues go beyond subject boundaries, it will be difficult to draw meaningful dialogue among the educators in various disciplines to overcome the current challenging issues in STS education.

Need for a Paradigmatic Shift in STS Education

How can we achieve a profound understanding of STS education? How can we cooperate with each other and overcome the challenging issues such as subject boundaries? For a better understanding of these two questions, I first suggest STS educators deconstruct their paradigms shaped by a narrow subject landscape or by the taken-for-granted scientific epistemology. The Figure 1 and 2 below represent, what I call, 'science-technology based approach.'

Figure 1. Image of traditional STS educational research.

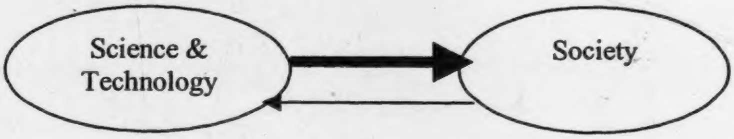


Figure 2. Mutual relations of science, technology, and society. (Waks, 1992, p. 16)

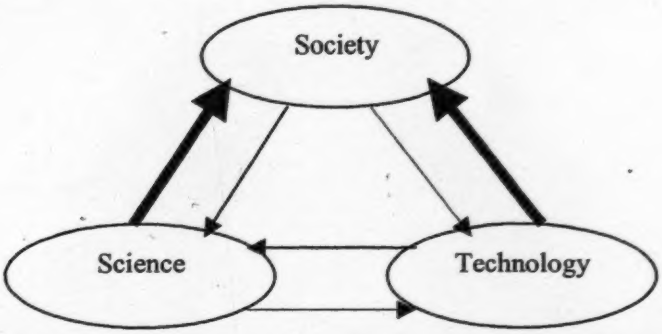
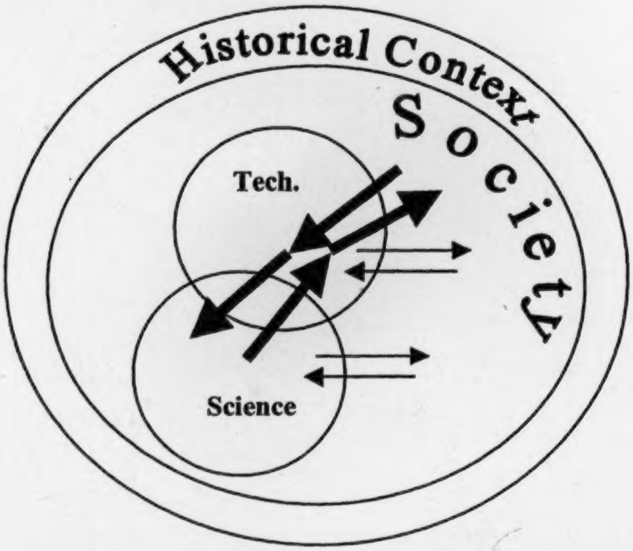


Figure 1 shows an image of traditional STS educational research which recognizes science and technology as rather a combined functional dimension by focusing on the impact of science and technology on society. Figure 2 recognizes technology as a separate functional domain and highlights its mutual relationships with society and science. However, both Figure 1 and 2 have two distinct common grounds in that both figures do not recognize science and technology in broader social and historical contexts and emphasize the impact of science and technology on society rather than the impact of society on science and technology. However, these two figures, science-technology based approach, lack the focus on the question of how does society affect the results, activities, findings, and products of science and technology? This is a very critical question. The second relationship (society → science & technology) is more important than the first relationship (science & technology → society) because the problems embedded in society are the fundamental cause of the misuse of science and technology. Figure 3 represents a reconceptualized image of the relationship of science, technology, and society.

Figure 3. Reconceptualized image of society based STS education.



In Figure 3, the role of technology as a threading zone connecting social values and science is emphasized because technology provides science community with funding and job market through which the goals and directions of government and industry are introduced or enforced to science community (Sassower, 1997; Newton, 1984). Thus, the bigger arrows in Figure 3 highlight the high volume of the value influence between science and society through technology. Above all, in Figure 3, both science and technology are situated and understood in socio-historical contexts, which emphasizes the impact of society on science and technology more than the impact of science and technology on society because the problems of science and technology fundamentally come from the general society. Without the cure of societal problems, the misuses of science and technology may not be reversed.

Value Criteria in STS Education

How can a lesson be implemented differently between the two paradigms? STS educators can interpret an issue, develop possible answers, and develop STS lessons in many different ways based on different value criteria. For example, a teacher, after finishing a lesson on the deforestation in Brazil, posed the following question:

> One policy issue deals with the relationship of loan forgiveness to deforestation of Brazilian rain forests. An additional issue might be: Should the U. S. boycott Brazilian products, to get the government to stop the deforestation? (Leming, 1989, p. 12)

According to the teacher, the purpose of the discussion is for children to form reasonable viewpoints on the ethical issue of deforestation in Brazil. In this case, the teacher should consider some other moral aspects of societal issues such as socio-political, economic, historical issues. For example, if the fact was considered that Brazilian economy was systematically monopolized by the United States government, the teacher's question would be different. Of course, boycotting can be a topic in this situation, but without a profound understanding of the social and historical understanding on Brazilian deforestation issue, the discussion on boycotting can be reduced to a dominant nationalistic representation.

While explaining ethics and values in STS Education, Leming (1989) used "the American Creed" by Myrdal and supports that Myrdal's the American Creed is "one list of values frequently used to defend one's own values in the United States" (p. 76). The values are:

1. The worth and dignity of the individual in the American Creed
    a. Equality
    b. Inalienable rights to life, liberty, and the pursuit of happiness
    c. Consent of the governed
    d. Majority rule

- e. Rule of law
- f. Due process of law
- g. Community and national welfare
- h. Rights to freedom of speech, press, religion, assembly, and private association (p. 77).

Leming (1989) also wrote other frequently cited American values such as honesty/truth, responsibility, promise keeping, loyalty, charity, property, liberty, life, and authority. Value criteria are the most influential basis that guides people's ethical judgment and subsequent action. Even if the same data are presented, different people would interpret a specific issue in different ways based on the different value criteria. For example, the above value criteria shows that Leming's value criteria depend on national values as well as basic humanistic values, but some of the above values such as majority rule, community and national welfare, authority, and loyalty can be highly misused in helping inflicting people when a nation engages in a war either with another ethnic group within its territory or with another nation.

It should be noted that community values such as group interests, religion, and nationalism must be respected because these values were generated by our commitment to the communal life and directly related to our lives. However, Kirman (1992), pointed out that "values such as perseverance, loyalty, respect for authority, obedience, and cooperation" were "exemplified by Hitler's SS units who operated the concentration camps and committed mass murder during the World War II" (pp. 7-8). He stressed that "values can be socially neutral, but become non-neutral in their application where others are concerned" (p. 8). For example, he explained that courage can be used for anti-social behaviours such as murder or robbery. Instead, Kirman (1992, 1997) suggested that the development of a personal ethic that values love, kindness, caring, and human dignity over all other values would guard against this kind of abuse. Noddings (2002) supported this idea by warning that we have to recognize the dark side of community values and study them so that we can overcome all of the negative aspects of community values. She gave us a serious moral question on community values. Noddings (2002) explained that "even war between nations can be traced to misunderstanding, to the narrow drawing of lines between people who perceive one another as reprehensively different, to the mistaken notion that oneself and one's friends must be protected from these others" (p. 37). Whereas maintaining a relationship of cooperation or mutual respect between each other in normal condition, nations sometimes brutally treat each other. When it happens, the peaceful relationship is degraded into the relationship of domination and subordination. This phenomenon can happen through other community values such as religion, ethnicity, regionalism, and race. What is apparent is that those community values have latent ideological aspects which can legitimate the infliction of suffering upon one another. In the age of globalization and technology, we should put more emphasis on educating humanistic values over these community values which contain possible relationships of domination and subordination. In recent years, the expansion of value criteria in STS curriculum is emphasized in STS education. Waks (1999) pointed out that "the global network society is now the most important topic for STS study" (p. 48). Hallak (2000) argued that the development and reform of school curricula should encompass both cultural values and universal or core values in order to cope with some of the challenges raised by a globalized world.

In this chapter, I have presented a detailed explanation of the assumptions I made in the Introduction. Solving STS problems and issues depends on the individual's existential moral capacity to know and transform the selves and the socio-historical structures of science and technology. Thus, STS education should be addressed in people's personal, social, and historical contexts and encompass humanistic values such as human dignity, dialogue, and respect and caring (for the self, others, and nature) which are essential values to living harmoniously with others in the age of globalization and technology. The next chapter envisions how reflection will help enabling children to have their moral capacity to cope with their existential conditions of science and technology.

CHAPTER IV

Moral Life and Reflective Capacity

Reclaiming the Individual as the Protagonist in Moral Education

In explaining the ethics in the age of globalization, Smith (2000) highlighted an important point:

> Identity is never a stand-alone phenomenon… Self implies other. If there is to be truth in the world, it will be only truth as shared, something between us. Such is the foundation for ethics in the age of globalization… In the context of globalization issues, however, the work is more complicated, with deep implications for both curriculum and teaching. Most especially there has to be a retelling of the historical tales such that the others who have been silenced under the triumphant narratives of empire are given their just due and embraced as necessarily contributive to any future worth sharing. (p. 23)

I am impressed with Smith's metaphor, "a retelling of the historical tales such that the others who have been silenced," which, I propose, can be obtained through educating reflective people based on humanistic values rather than harsh class struggle. Historically, knowledge in civilized societies was mainly influenced by a variety of ideological aspects. Some of the examples might be male-domination, religion, and politics. Who made nations? Who made laws to govern nations? Who built knowledge? It would be reasonable to say that our human history was dominantly written by males, the ruling class, or high-level intellectuals. Knowledge was, in a sense, both the product and dynamic of this alienating human history.

For example, we often see history textbooks particularly in former major imperialist countries proudly showing and distorting their history of imperial expansion into the other world instead of showing repentance for all the wrongdoings they made on their parade of imperialism. What we may be missing here might be the lost story of a peasant woman's daily life 200 years ago. Imagine a peasant woman in Korean feudal society. She has to get up early in a bitterly cold morning in winter and carry a wooden bucket on her head to the well in her village to obtain water for cooking rice. How could edible rice be obtained? She hits every sheaf of rice to drop the grains of rice off to the ground. Then, she steps on a treadmill to hull the raw rice. Finally, she winnows the hulled grains of rice to separate the useless residues and grits mixed with edible rice. To obtain wood, she has to walk a long distance and climb up a very rugged mountain because the mountains nearby have already been naked due to people's deforestation practices for wood. Then, she cuts pine trees with an axe or a sickle and bundles them up with arrowroot vines. Finally, she carries the big bundle on her head to her home. She washes clothes by hand in a stream in bitter winter and makes clothes out of raw cotton for her parents-in-law. She just continues all the routines she is supposed to do in order to enable the survival of her family members. But her story is missing in any of Korean textbooks. If people had been interested in her pains, joys, sorrows, and stories she carried, we might have written a more democratic and caring history than the one we live with now. Could human beings have survived without her breastfeeding or cooking? It will be a good start, if educators teach her life meaning stories of caring, wisdom, endless alienated life in a male-dominant culture. While reflecting on her story, children may have a better possibility of feeling caring, valuing caring, responding to caring aesthetically, and, thus, growing morally by overcoming the negative aspects of today's world characterised with excessive materialism, competition, and egoism. I personally believe her invisible caring and wisdom is the most precious knowledge we have often missed throughout our long human history.

Connelly and Clandinin (1988) emphasized the role of education by stating that education is "a narrative experience that grows and strengthens a person's capabilities to cope with life" (p. 27). By this, they emphasized that guiding children to have capacities to construct meaningful lives in relation to others should be the primary focus of our educational endeavour rather than controlling, operating, or reducing their life experiences. The individual who often lived as the mere subjects controlled and indoctrinated by powerful ideologies should reclaim oneself as the protagonist in moral education.

Place of Emotion, Aesthetics, Will, and Reason in Moral Life

STS research studies in education have mainly contributed to the development of children's moral reasoning and decision-making skills in relation to STS issues through a rational approach[6] (Hogan, 2001; Gayford, 1993; Leming, 1989). Brinckerhoff and Zeidler's (1992) resource guide, *One Minute Readings*, is a good example of a rational approach. They developed resource materials for teaching societal and ethical issues in chemistry, physics, and biology. While the teaching methods are based on Kohlberg's (1984) developmental theory, their teaching strategies are mainly composed of multiple-choice questions, hypothetical moral dilemmas, and opposing debates. Kohlberg's developmental theory is based on the belief that because all people, regardless of gender, culture, or social class background, develop with age and, thus, development has been viewed as an important route through which to focus moral education curricula (Nucci, 2001). Kohlberg's developmental theory has contributed to the cognitive understanding of human morality through both extensive and intensive field research.

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[6] Historically speaking, according to Anscombe (1958), Kantianism and utilitarianism are the two major rational traditions in western moral philosophy, and they placed the foundation of morality in legalistic notions such as duty and obligation. For example, Kant believed that reason, which is one part of us, retains control over the other part of us, affective dimension, through performing our duties of virtue.

Despite its considerable contribution to moral education, most moral educators today criticize Kolberg's developmental theory by arguing that emotional, aesthetic, and volitional dimensions as well as rational dimension are all the inseparable part of moral growth, and these dimensions are as unique and important as rational dimension (Noddings, 2002; Walker, 1998; Meyers, 1994; Connelly and Clandinin, 1988; Gilligan & Attanucci, 1988).

Gilligan & Attanucci (1988) criticized that Kolberg's developmental theory, based on the dominant ethical traditions, speaks the languages of masculinity, justice (rights and duties), and hypothetical perspective, and they, instead, emphasized that people need to be able to articulate their moral concerns in other than these languages such as the languages of feminine, emotional, care, and real life perspective in moral education. Meyer (1994) pointed out that the ability to empathize with others and imaginatively construct their unique viewpoints is critical to moral insight and wise moral choice, but ethics that base moral judgment on a universal conception of the individual marginalize this skill. Noddings (2002) also expressed concerns by stating that, "there are worries about moral principles, decisions made in abstract isolation, the assumption that what is right can be determined in the abstract, logically, without hearing what others are actually going through" (p. 19). For example, the teaching methods frequently used in a rational approach such as hypothetical moral dilemmas, mock parliament, values voting, and opposing debates are useful in helping children to form reasonable moral decision-making. However, they must be used with careful consideration because using these strategies, isolated from children's real life, rich contextual understanding, and humanistic values, may bring up competitive, argumentative, unrealistic, impractical, or other undesirable moral values. Thus, it is desirable for educators to select topics based on children's real life situations and interests and help them to actively feel, reflect on, and practice the moral issues out of their own judgments based on their personality, ability, interest, and social setting.

Aesthetics is another dimension contributing to children's moral growth. During the Second World War, the art and the music of the Nazi propaganda, as was the case of reason, were used for the indoctrination of nationalism, loyalty, and courage, which degraded art into the relationship of domination and subordination. An important point is that aesthetic values are deeply related to children's moral growth. Connelly and Clandinin (1988) pointed out that "to know something is to feel something, to value something, and to respond aesthetically." They explained that knowing comes from narrative experiences with people and in contexts that happens over time through which a person grows intellectually, emotionally, aesthetically, volitionally, and morally. Kim, Kwon, & Kang (2003, p. 16) criticized the educational practices of rote learning in Korea by pointing out, "teacher-centered rote learning breaks up the interrelationships of morality, aesthetics, and life, and it ultimately dries up the liveliness of our life." Feeling something aesthetically is a unique ability by which a person constructs meaningful moral practices. When children create their own meaningful experiences with others through aesthetic capacity, their morality becomes more beautiful beyond the boundaries of simple right or wrong moral judgment.

Despite the different traditions of the above critics, they suggest some important insights on the direction of future moral education. First, since the self is understood as socially and historically situated, the understanding of moral growth is grounded in the individual's life experiences. Second, constructing one's moral life also depends on human beings' emotional, aesthetic, and volitional nature as much as it depends on their capacity for reasoning. These capacities are not to be governed by reason but contribute to an individual's meaningful moral construction by leading reason in right ways. Third, the moral growth of the self is understood as the individual's existential pursuit of creating meaningful life through her or his unique reconstruction of life experiences.

An individual's existential pursuit of creating meaningful life belongs to volitional dimension, and it ultimately leads a person to build a whole moral self through moral action. A person is the only biological individuality who feels pain, sorrow, joy, and happiness and creates human meaning through interactions with others. Even if social or cultural structures mould human beings' morality, it is the individual who operates those structures, and it is ultimately each person's consciousness and action which can change the immoral social or cultural structures she or he lives in.

Reason is an important human capacity by which humans not only can overcome individual differences, diversity, and egoistic community values but also can create a shared space of communicative consensus to live with others as global citizens (Habermas, 2001). However, in order to deal with reason as a meaningful discussion in moral education, we should not make the fallacy to subjugate emotion, aesthetics, and volition to reason. This is the reason educators need to grow and strengthen children's capacity to feel something, value something, respond aesthetically, think intelligently, and put their knowing into action based on humanistic values. The culture in which our children will live is different from the one in old times which had enough power to subjugate people to its territorial boundary. To children who will live in a highly globalized technological society, the world implies a single cultural community which is inseparably related to their own lives. Children should be educated in humanistic values which enable them to live with others as global citizens by overcoming the egoistic representations of isolated cultures or community values. Thus, the goal of moral education in an age of technology and globalization should contribute to growing and strengthening children's moral capacity to live with others as global citizens. I found this possibility through educating children to develop reflective capacity in emotional, aesthetical, and volitional, and intellectual dimensions based on humanistic values.

Background of Reflection

In contrast to the large amount of research on reflection, particularly, in the areas of teachers' and pre-service teachers' reflection, there is little literature that discusses elementary children's reflection in schools. The exceptions are the quantitative research studies mostly in the area of meta-cognition, which are focused mostly on young children or adolescent (Davis, 2003; Bernfeld & Peters, 1986; Kontos, 1986; Brannigan, Ash, & Margolis, 1980; Stein, Prindavill, & McGlannan, 1976). In addition, I have found no research in the area of both quantitative and qualitative STS studies in relation to elementary children's reflective activities. Reflection in psychology is mostly defined in the area of meta-cognition. Kontos (1988) defined meta-cognition as the knowledge and awareness of one's own thought. Kuhn (2000) defined meta-cognition as cognition that reflects on, monitors, and regulates cognition. In addition, he stated that issues regarding an individual's ability to reflect are the kernels of meta-cognition. Brown (1997) explained that fostering meta-cognition can be obtained by reflective activities such as constructive discussion, questioning, querying, and criticism, and she further points out that "in time, these reflective activities become internalized as self-reflective practices" (p. 406).

However, reflection in meta-cognition is mostly defined rather as a narrower functional construct providing researchers with quantified tools for measuring a variety of differing purposes such as language acquisition and academic achievement. For example, some researchers use the amount of time or the number of errors, as the main variables to define reflective children with a purpose of comparing them with impulsive children (Bernfeld & Peters, 1986; Brannigan, Ash, & Margolis, 1980; Stein, Prindavill, & McGlannan, 1976). Moon (1999), explained that "reflection has not often been a topic for research and is generally not a recognized construct in psychology, making it difficult to reach useful conclusions about the relationship between cognition and reflection" (p. 94). Thus, it can be presumed that reflection in understanding children's experiences has been mainly dealt within the cognitive dimension by quantitative research, not in the areas of emotion, and aesthetics, internal will, and meanings. However, as far as ethical judgment and action are affected by all of these dimensions and their complex dynamics (Ziman, 2000), it is indispensable to attend to all these dimensions and their internal dynamics of children's reflection.

Reflection as an Individual's Emancipatory Moral Capacity

John Stuart Mill (1975) suggested a practical self-reflection which is different from Hegel's idealistic self-reflection. He pointed out that the socio-historical context in which an individual is situated moulds her or his moral character and that self-reflection empowers an individual to change the dehumanization of one's immoral socio-political structures, which, in turn, becomes the basis of becoming a moral person—He viewed that the immoral cultural and family structures are basically the dehumanizing socio-historical structures to be changed. He also believed that the way the individuals can change the immoral socio-historical structures is possible through individual's practical deliberation.

Habermas (1971) argued that "the pursuit of reflection is a movement of emancipation" (p. 198). Habermas (1971) saw that reflection is "a self-formative process" (p. 197) based on the power of reason and free will, which eventually leads to the development of emancipatory capacity. Thus, to Habermas, reflection is an individual's conscious emancipatory process by which an individual awakens and transforms one's moral selves and the immoral socio-historical structures which alienate and dehumanize human lives.

It must be also noted that reflection in critical tradition should be dealt with cautiously. As Friere (1971) pointed out, without being aware of our full humanity and continuous self-criticism, critical reflection neither justly contributes to the ideals of emancipation from the immoral socio-historical structures nor helps us to become dialogical beings. He saw reflection as an individual's conscious awareness of knowing and transforming the self, the reality, and the world, and thus, he envisioned that reflection takes on meaning when it leads to action—the praxis of reflection and action because his primary concern of reflection is social change by arguing that "to exist, humanly, is to name the world, to change it" (p. 76). He further argued that humans should have the ability to understand the structured context critically in order to perceive reality as process and as transformation. However, Friere (1971, pp. 77-81) also emphasized a) a profound love for the world and for human beings, b) humility, c) an intense faith in his power to make and remake, to create and re-create, and faith in his or her vocation to be more fully human, and d) hope which is rooted in human beings' incompletion from which they move out in constant search—a search which can be carried out in communion with others. Therefore, according to Friere, critical reflection is meaningful when it leads to action based on the awareness of our full humanity and continuous self-criticism.

Becoming a Reflective Child

The interest in reflection in the educational sense dates at least back to Lao-tzu and Confucius in China, Buddha in India, and Socrates and Aristotle in Greece. The importance of reflection as a modern educational term was first raised in the writings of Dewey (1938). For children's reflection, Dewey (1938) stated:

> There should be brief intervals of time for quiet reflection provided for even the young. But they are periods of genuine reflection only when they follow after time of more overt action and are used to organize what has been gained in periods of activity in which the hands and other parts of the body beside the brain are used. (p. 63)

Partly by referring to "the use of the hands and other parts of the body" and partly by referring to "they follow after time of more overt action," Dewey here saw that children grow by learning from active experiences and genuine reflection. He explained that education, to achieve its goals both for the learner and society, must be based on experiences. For Dewey, experiences are always in relation to others over time. The central concern of experience in education, according to Dewey, is to select the experiences that lead to subsequent experiences fruitfully and creatively. However, the subject of constructing experiences is always each child, not the teacher. In other words, experiences are the individual's existential pursuit of constructing one's life in personal-social and past-present-future contexts.

For Dewey, reflection is also always relational because of his relational understanding of experiences. Thus, children create more meaningful experiences by reflecting on one's experiences in relation to others over time. According to Dewey (1938), experience can reach a conclusion, but it is not a simple end. Both teaching and learning continue to grow interchangeably by the consistent shaping and reshaping of each other through the reflective process of experiences. Reflections of their life experiences both enable children to feel and think more deeply about the meanings of their experiences and provide them with a footstep through which they actively make sense of other experiences and, thus, grow intelligently, emotionally, aesthetically, and morally. Dewey (1938) named this process as "the experiential continuum" (p. 33).

Dewey's concept of the experiential continuum reminds me of Bin (pseudonym), one of the student participants in this study. Far from 15 reflective activities, I only show her growth of reflection based on our conversations and the final interview. Bin had watched TV about an average of 5 hours a day before she engaged in our study. She enjoyed every program such as news, talk show, comedy, music, documentaries, and even political debate, but she made a decision to reduce her time with TV. The reason was that she had a hard time getting up in the morning because she was watching TV until late at night and, then, worked on her homework, which made her go to bed at midnight in most cases. She worked on her bad practices of watching TV by writing her reflective stories in her STS practice journal. As a result, she succeeded in reducing her TV time to about 30 minutes a day. Bin had been successful for about 50 days until the last day of this study. At the final interview, Bin told me her reflections as follows:

> I don't watch TV much still. I mean… I have Han Game… Buz Game [These are Korean websites providing a variety of free games such as chess.] I play those games. I also play Bogulbogul Game with my elder brother and work on workbooks. I don't do my homework, but I solve questions in my workbook. My elder brother works on

> his workbooks together too. So it helps me to study more. I reduced TV time and play chess game with my elder brother. I feel good with these. I have much time talking to my family and my family are much happier with it. (Interview, 12/28/2003)

Even if it was hard for Bin to change her long-standing habit, she came to have much more things than just her time to spare for her homework as shown above. Her first endeavour of reducing TV time led her to move to some more meaningful experiences.

On December 5 (Researcher's Journal, 12/5/2003), Bin came to me and said that she would change her habit of having an unbalanced diet and using bad languages. When I asked why, she responded that she had been using bad languages so much and wanted to change it. I wondered how she related bad language and food to science and technology. "How is bad language related to science and technology?" I asked. Bin responded, "Transportation has been improved. So people eat the food which was not affordable in old times. Like fish… We eat all kinds of food even in winter such as vegetables." I asked another question, "How did you relate bad language?" Bin responded, "Children really use a lot of bad languages these days. They learn these by doing Internet chatting or by reading Internet fictions. Are they all possible with the development of science and technology?" Thus, Bin consciously recognized some abstract concepts as the influence of science and technology far from the visible things in her daily life.

However, Bin had a great difficulty in reducing the use of bad languages:

> Reducing the use of bad language was the most difficult. I put all Xs [on the weekly practice checklist in her STS practice journal] during the first week. ['X' means 'no' and 'O' means 'yes' in Korea. By this she meant that she used bad languages everyday.] Next week, I didn't use bad languages for two days. Then children at the back of my private institute speak words [bad languages]. If I were involved, I would speak words [bad languages]. But I controlled and didn't use bad languages… I couldn't speak to others because I have a mind that I shouldn't use bad languages.

> This made me live quietly. When you don't use bad languages, you feel good. Right? Then, I feel good and the other person would feel good. So, it is good to each other. But I feel lonely because of this. It is likely that if I try one day and another, things will be improving step by step. (Interview, 12/28/2003)

Bin also told me about her experiences with having a balanced diet:

> *Bin:* I did not used to think anything about the food I ate. But with practicing this [STS practice journal], I don't have unbalanced diet any more, and I think whenever I eat. When I do well, I feel proud of myself. When I do well, I feel proud. So, I continue to do well because of that.
>
> *Researcher:* So how did you feel when you have a balanced diet?
>
> *Bin:* You know. I sometimes feel sick when I eat any food I don't like. But I chew it well. If we chew it well, it must be good to our health. So I think about this and record my STS practice journal and continue to do these. Now the food I didn't like are all gone and I've become used to eating all the food my mom cooks for me. By doing this, I have changed my bad habit, and I am very proud of and feel good about myself who is able to change like this. (Interview, 12/28/2003)

It is noticeable that Bin's reflection keeps the harmony of emotional, aesthetic, volitional, and rational dimensions. She expressed all of her difficulties while practicing the goals she had set. Nobody forced her to do those practices. Bin's reflection happened when she felt and thought of her daily experiences. She set the goals for herself, overcame the difficulties, and led to more meaningful practices. By reflecting on her practices again, the practices didn't mean a simple end but became another footstep enabling her to search new meaningful experiences. On November, 22, in the middle of her practice, she reflected on her former bad practices of watching TV as follows:

> I was watching TV while undressing, dressing, and eating meals. I even watched TV for five hours just right before my school achievement test date. I didn't feel that TV wouldn't affect me much. But I now know that TV really affects my life. I saw news because it was interesting. After that, I saw drama too. And I saw 9 o'clock news

> again… The longest hours I watched TV was 23 hours in a row… (STS Issues Meeting[7], 11/22/2003)

Thus, Bin's reflection happened throughout the whole process of her endeavour. Based on this experiential continuum between active experiences and genuine reflection, Bin grew emotionally, aesthetically, volitionally, intellectually, and thus morally.

After the last interview with Bin on December, 28, I was about to leave the site. At the moment, she caught me again by saying "Teacher, there's another thing I learned from this."

> *Bin:* You know. By doing [learning] science and technology lessons, writing STS practice journal, listening to many stories, writing my thinking and feeling, it has influenced my life. By doing these, I've come to think more. That is… There is no right answer. [By this, she means there is no predetermined answer.] So, I had to find and write something for myself. And I wrote my feeling and think my writing again. I continue to think like this.
>
> *Researcher:* How does your thinking influence you?
>
> *Bin:* That is. When I think more, I come to think the thing I simply thought about [before] and extend my thinking to some extents. Then, many things occur in my mind. By this, I become… What can I say? I don't know how others would feel, but I feel I know well because I think much more. It is really good to write in my notebook and see it again and write it again.
>
> *Researcher:* How do you think your thinking has changed?
>
> *Bin:* Before I learned this, I hadn't thought about science and technology at all. And I just studied, came to school, and again I ate and went to my private institute. I just lived as it had always been. As I studied about science and technology, I've come to know that there are so many things which are related to science and technology. Now, when I see an audio recorder, I come to think about how it works and I imagine much more…
>
> *Researcher:* Would you give me an example?

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[7] In this study, the home room teacher held STS issues meetings regularly on a voluntary basis to provide a reflective space in which children addressed their daily STS issues at the meeting.

> *Bin:* (After a while of pause), my father smokes a lot of cigarettes. You know people smoke easily by buying them in a nearby store because of the development of science and technology. But those are very harmful. So, I come to search for some [helpful] reports about cigarettes in Internet. Since I did science and technology, I've happened to imagine my father being sick because of cigarettes. So, I want to help my father to be able to quit smoking. But I don't know what the right ways are…
>
> *Researcher: How* do you think your thinking about people has been changed?
>
> *Bin:* After listening to Sadako Sasaki's story[8], I thought this way. At the time Japan did such [invading Korea], it was likely that Japanese government did wrong things but not its citizens. Common people live what they are supposed to live. Japanese government ruled over our country. However, not every citizen ruled over our country. That's why we fought against Japan. What I am saying is Japanese common citizens are not much responsible for that [Japanese invasion]. They just live their lives. I mean they killed our citizens simply because they had to do what they were supposed to do. But people are not destined to death. People can change their lives. I think common people are not much responsible for the many people who suffer, die, and become weaker from the bomb… I think much more and I picked up a habit of thinking. At the beginning, I thought about bad things more. For example, when I see a camera… You could see that on TV. When someone installs a hidden camera on purpose, it violates someone else's private life. But now those things faded away [in my thinking]. When I think of something, now I see positive things more and I like it. When I see a person, I see that person in a positive way first. I like that. (Interview, 12/28/2003)

By her saying "when I see a person, I see that person in a positive way first," she meant she would think about a person in her or his position first and then judge. She learned this from listening to Sadako Sasaki's story because she once hated everything about Japanese, but she knew that Sadako Sasaki was a real victim and a good person who wished for world peace till the moment she died.

Both the teacher and I observed Bin growing emotionally, aesthetically, volitionally, intellectually, and morally. When I first met Bin, she said she had not thought whether she or other adults use science and technology neither rightly or wrongly. However, as time went on, Bin made sense of her daily STS issues in relation to her personal and social contexts and her past, present, and future contexts through reflection. I saw her intelligence, emotion, will, and morality were all beautiful when she talked about her worrying about her father's smoking. I saw a decent flow of her morality—moral sensitivity, moral decisions, and moral action—embedded in Bin's language and body when she was reflecting on her struggle of bad languages, unbalanced diet, and TV time. Bin's reflection, first, provided her with time and space to think more deeply and relationally about what had really happened with the struggle, second, allowed her to actively make sense of the moral issues embedded in the struggle, third, led her to set the proper practice goals from her own practical judgments based on her internal conditions and existential conditions, fourth, enabled her to lead to the proper practices by overcoming her difficulties, and fifth, became a new experiential footstep for further meaningful experiences.

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[8] The homeroom teacher told Sadako Sasaki's story as a reflective activity in this study. Sadako was the victim of Hiroshima atomic bomb, and she tried to make 1,000 paper cranes for her wish toward world peace. But she died from leukemia when she had made only 634 paper cranes. Her story has been widely read in North America. Her story is not popular in Korea because Korea was liberated from 36 years of Japanese rule because of Japan's unconditional surrender right after Hiroshima atomic bomb was exploded in Japan.

Becoming a Reflective Teacher

Teaching is a truly complex and difficult job. As Vinz (1995) points out, we have to continue to ask ourselves the question "what should we, as teachers, know, be able to do, and believe?" (p. 32). A teacher constructs her or his teaching by interacting with others in complex and multiple decision-making situations. Teachers confront a variety of stakeholders who have different standpoints on many different educational issues. Some of the examples are government, parents, community, administrators, university professors, interest groups, politicians, funding agencies, and industry. Teachers also have a variety of agendas to consider such as teaching guidelines, legal responsibilities or duties, traditions, community values, and parental demand. On the other side, becoming a teacher is also very personal in that it encompasses those considerations such as a teacher's values, personality, teaching style, worldview, and attitude. Thus, becoming a teacher, as Vinz (1995) stated, requires continuous reformulation of the self in relation to her or his existential conditions in a continuum of one's life journey as a teacher.

Teacher Nara's (pseudonym) story with her student Jinmi (pseudonym) in my pilot study[9] tells us that the pursuit of reflection is a continuous existential pursuit of knowing and reformulating her moral selves to become a good teacher.

Jinmi is one of the student participants in our focus group during the pilot study. To me, Nara seemed somewhat concerned about putting Jinmi in the focus group at the beginning because of her lack of participation. After a while of conversation, we decided it was right to put Jinmi in the focus group, as she was motivated to be a part of it. An interesting happening occurred during the very first lesson. After reading the first chapter of Nobel's biography detailing his family environment, Nara initiated a question, "When Nobel was young, what was he like?" Jinmi responded with a unique idea by saying, "He inherited his father's talent and capacity to become an inventor. He seemed to respect his father, and he was weak and liked to stay inside. These made him study very hard." (Field Note 2/7/2003) I was shocked by Jinmi's unique ideas at the moment. When Nara and I came together for our regular meeting after class, Jinmi became a major agenda in our conversation. Nara mentioned she was also surprised by Jinmi's ideas during the class, and Jinmi's participation continued to become our agenda throughout the whole study. During our second regular conversation, I praised Jinmi frequently, however, Nara responded quite seriously to my praise. Nara told me that Jinmi was one of the lowest academic achievers and was living in an extremely harsh family condition. Nara said, "Jinmi sometimes wrote 'I do not want to live anymore'. Like... I can see sorrow coming out of her diary." (Regular Meeting, 2/7/2003) On the third day, I praised Jinmi's critical thinking skills. Then, after a while of serious pause, Nara recommended, "Would you tell her those aspects directly?" I said, "Yes" and Nara wanted me to tell those even in a later time. Nara added, "That's because it is likely that she is a student who has little positive thinking or confidence toward herself" (Regular Meeting, 2/8/2003). We continued to enjoy Jinmi's writing and participation throughout the pilot study, but whenever I mentioned Jinmi, Nara became slightly perplexed.

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[9] In my pilot study, a 5th grade class students and their homeroom teacher were chosen as participants. Fourteen lessons were constructed and taught in the two weeks between Feb.6, 2003 and Feb. 19. 2003. We used the following reflective activities: brainstorming, journal writing, NIE (Newspaper In Education), biography, interview, historical inquiry, participatory inquiry, artwork, and storytelling. Fourteen 5th grade students participated in this study, however, I only observed, talked with, and interviewed the focus group (two male and two female students).

During the pilot study, students wrote reflections in their STS journal regarding STS news or reports, their daily STS issues, and their own STS practices. The following is Jinmi's writing in her STS journal. Jinmi cut and posted a picture of a couple that met each other through phone chatting and got married and she writes:

> It was lucky that these couple met each other, but what if someone would meet a dishonest person? Even though the above couple met by their good use of chatting, it would have been a big social damage when they had met a dishonest person. So we need to think deeply when we use science and technology... (STS Journal, 2/04/2003)

As shown above, Jinmi's reflections on the moral issues of science, technology, and society surprised Teacher Nara and me everyday.

On our last day, Nara talked about Jinmi several times and it was interesting to hear that Nara related many of her memories of our collaborative research to Jinmi. When I asked, "What do you think of our project in terms of children?" Nara said:

> …I like these ideas [of this project]. Most of all, I wish Jinmi will remember this memory at this time. I wish the self-confidence and the active attitude learned at this time will be the foundational cornerstone of her future environment. It would be hard for anyone to praise and encourage her… I looked what I missed once again because you [the researcher] praised the ones I missed. (Interview, 2/20/2003)

Finally, I asked, "Do you have any other stories you haven't told yet?" and Nara began her response with a little hesitation:

> *Nara:* At the beginning, there was just one consent form… Can you remember who it was?
>
> *Researcher:* That is…
>
> Teacher: Jinmi's consent form!
>
> *Researcher:* Ah. That was Jinmi's? [I could not remember. Perhaps I was too much stunned with her notice that only one consent form was returned.]
>
> *Teacher:* When I saw her consent form… I was a bit perplexed. So I thought how much she would help [for our research]. She was kind of labelled as a "slow learner" in my brain.
>
> *Researcher:* She was the best!
>
> *Teacher:* That is right. When I saw Jinmi's consent form, I was kind of completely lost. Therefore, I think that labelling a student in one way or another would be the worst thing teachers must avoid. That is the strongest impression [out of this research]. However hard my situation may be, I think it is not right to judge a student out of my preconception or a single behaviour of any particular student. I really feel sorry for Jinmi. I was really worried about the first consent form because you said you needed at least four students. I could fill the numbers but I couldn't decide whether Jinmi should be in or out. It is not a good behaviour to let her out because she was the first volunteer but I was also not satisfied to let her in. So after a while of serious worry, I decided to put her in the focus group. Then, the result shows that she was the most active… Her way of expression was so unique… and I think it would have been so

> bad if I had taken her out. If Jinmi had noticed my intention, she would have been badly hurt and then I would have continued to carry the label of a slow learner all the time. I really feel sorry for her and this is the strongest memory I have now. (Interview, 2/20/2003)

At that moment, I noticed Nara was about to cry, and I could feel that she was transforming her identity as a teacher by learning new meanings out of her experiences with Jinmi. Nara's transformation at this stage meant her shift from the mode of having to the mode of being. Nara said she had lived with a kind of fixed frameworks on how children should be in terms of their morality, academic achievement, and school life. Children were easily interpreted and evaluated based on the fixed frameworks she had. If we had decided not to include Jinmi in our study, it would have been a representation from our egoistic mode of having. However, Nara had Jinmi participate in the study, which means Nara understood Jinmi's life as a whole person, searched her meaningful part of contribution to Jinmi's growth. After all, Nara's contribution became a meaningful part of Jinmi. Owing to Nara's caring, Jinmi responded volitionally to Nara's caring by her active meaning making into this study. Thus, Jinmi's volitional response to Nara's caring is another way of becoming a meaningful part of Nara's life as a teacher. Again, Jinmi's growth helped Nara to reflect on her becoming a teacher. Nara's existential consciousness by reflecting on who she is, who she was, and who she will be for the growth of Jinmi led both of them to be able to create a precious mode of having.

From this pilot study, I could feel the power of reflection and how it works. I know that, from the beginning to the end, Nara continued to reflect on the experiences with Jinmi by going to the past, to the present, and the imagined future, by going between her personal and social contexts in a reflective space of working with STS reflective activities. Nara's reflection during this pilot study resonated with many other aspects of her becoming a teacher: teacher identity formation, the relationship with each child, teaching method, professional landscape, and curriculum planning. A space of working with STS reflective activities was not just about developing a strategy or a simple understanding to be applied, but our story tells that this study also became a space of knowing and transforming how to become a good teacher through reflection.

Meaning of Reflection in the Study

In the study, my understanding of reflection was influenced by a) Dewey's (1938) concept of experiential continuum that reflection enables children to think more deeply about an STS issue, provides children with a background through which they actively make sense of other experiences, and, thus, leads children to grow through the reflective process of experience, b) Connelly and Clandinin's (1988) concept of knowing that knowing is narrative experience with people and context over time, which encompasses intellectual, emotional, aesthetic, volitional, and moral dimensions, c) Friere's (1971) concept of reflection as an individual's conscious awareness of knowing and transforming the self, the reality, and the world based on humanity, self-criticism, and the praxis of reflection and action, and d) the insights from the pilot study and my personal experiences that meaningful reflection occurs when a person positions oneself between one's internal conditions and existential conditions and when a person positions oneself among the past, the present, and the future. Based on the above understandings, I reconceptualized reflection in this study as an individual's narrative experience of knowing and transforming one's moral selves and one's existential conditions of science and technology based on humanistic values such as human dignity, dialogue, and caring and respect (for the self, others, and nature).

CHAPTER V

Collaborative Narrative Inquiry

Narrative Inquiry as an Ontological Experience

This study is a meaning-making process among people—children, their homeroom teacher and a researcher. Lambert (1995) proposed that narrative research helps us to construct meanings by saying that stories "have the power to help define who we are, to foster growth and development, and to help us envision our possible futures" (p. 7). Clandinin and Connelly (2000) further explained that story is not simply the outcome of a narrative inquiry for improving understanding in a field, but story becomes the origin of change empowering us to make meanings over time in our lives. Claindinin and Connelly (1992) highlighted that "life is a story we live by" and "people make meanings of their lives through story" (p. 12). By this, they meant that narrative inquiry itself is another storied experience of learning, envisioning, and becoming as a human. Thus, the stories we write during our collaborative narrative inquiry are not just the outcomes of our inquiry but are the meaningful stories we will live by as humans. This suggests that our collaborative narrative inquiry must allow a teacher to play a leading role in research from curriculum planning and organization to data generation and interpretation based on her own philosophy, values, and meanings. No matter how effective a curriculum may be, it will be less likely lead to meaningful experiences for our children unless it becomes meaningful to teachers. Teachers should be actively involved in research as active researchers or curriculum planners so that our school curriculum can be more meaningful to teachers as well as children. In this collaborative inquiry, the classroom is where a teacher and I both share each other's agenda, purpose, curriculum planning and organization, evaluation, and interpretation based on trust, negotiation, and cooperation. Clandinin and Connelly (2000) told us that "we work within the space not only with our participants but also with ourselves" (p. 60). By the time the teacher and I envision our own lives and tell stories, the stories become the stories we will live by as educators.

This is the same with children. A teacher's guidance should be based on respecting children's own unique personality, capacity, interest, and social setting so that they can construct their own meanings actively and creatively in a place of working with STS reflective activities. This meaning making process allows children to perceive that the stories they make are the stories they will live by. In the pilot study, for an example, Haemi (pseudonym), one of the student participants, often talked to her parents with a purpose of learning how technology has changed our lives. After listening to her parents' stories, Haemi spent many hours reflecting, drawing, interpreting, or writing for her presentation in class. Haemi told me that listening to her parents' stories provided a chance to understand them better. (Final Interview, 2/17/2003) Haemi told me that she could hardly see her father because he was always busy working. Her father went to work on Sundays three times per month, and this made her feel shy and strange when she saw her father at home—Koreans regularly work on Saturdays too. But Haemi said that because she had topics to discuss, it was much easier for her to talk to her father, and the talk led to other topics such as her father's old stories, which ultimately enabled her to make a good storied life with her father. Therefore, this study provides us with a reflective space in which we all lead a shared ontological experience of knowing and transforming who we are in relation to our existential conditions.

Narrative Inquiry as an Epistemological Experience

This study works within "a Three-dimensional Narrative Inquiry Space." Clandinin and Connelly (2000) base this term on Dewey's inquiry concepts of experience: interaction (personal and social), continuity (past, present, and future), and situation (place). According to Clandinin and Connelly (2000), an inquiry starts in a place where issues of interaction take place with people, context, and uncertainty over time. In this study, children's STS reflective activities are the issues of interaction through which a homeroom teacher and I work with children in a place of STS reflective activities over time. There is uncertainty in this place because we all have different experiences shaped in different places. As I enter the classroom, I bring my own stories. The children and the teacher bring their stories and experiences. It is our responsibility, mine and the teacher's, to build a meaningful "nested set of stories" (Clandinin and Connelly, 2000, p. 63) from which to create, together with our students, the larger stories we live and experience along the way.

The notion of interaction (personal and social) fits into this study. Clandinin and Connelly (2000) explained, "By inward (or personal), we mean toward the internal conditions, such as feelings, hopes, aesthetic reactions, and moral dispositions. By outward (or social), we mean toward the existential conditions, that is, environment" (p. 50). For children, it is envisaged that reflection guides children to make sense of their daily STS issues, make moral decisions, and take moral actions by moving between personal and social. For example, Haemi in the pilot study talked about her struggles with the overuse of computer many times throughout the study, and she constantly moved between personal and social. Haemi talked about her internal conditions as follows:

> Computers, when sending email, I have to stop after writing what I wanted to write, but I couldn't resist searching what other people do again and again. You know people have those kinds of minds. I want to control these kinds of minds, and then things will be more comfortable. (Conversation, 2/10/2003)

Haemi felt uncomfortable partly by overusing her computer and partly by not controlling such behaviour. She also talked about her existential conditions as follows:

> When playing computer games, I continue to think I should stop but I can't because it is fun… And my younger sister wanted to use it, but I continued to use it. And my younger sister got mad and told my mom, and I just had to leave my seat because of my mom's reproof with mixed feelings. I was struggling between the mind of "I want to do more" and the mind of "It's good to stop here." I think I have to set a time [of using computer] and take an action. (Conversation, 2/17/2003)

Haemi's internal conditions led her to put herself in relational contexts with her sister and mother. Then, she reflected on what had happened in these relational contexts and made sense of the moral issue of what she would do for her sister. She told me that she negotiated the time for using their computer with her sister in front of her mother on February 22. Thus, children's reflective experiences are essentially relational between their internal and existential conditions by which they pursue their meaning making stories. This is the reason I believe that children's reflective experiences can be best understood by the stories they tell, write, and make through their body and language. By inward, this study explores children's personal dimensions such as personalities, abilities, feelings, hopes, aesthetic reactions, and moral dispositions. By outward, this study explores children's existential conditions such as family, school, and social environments. This is the same with the teacher and me. Our collaborative inquiry teaching and learning explores the reflective experiences of how we think and rethink who we are as a teacher and a researcher in our personal-social contexts.

The notion of continuity (past, present, and future) fits into this study as well. In emphasizing continuity as a central figure, Clandinin and Connelly (2000) explained that "whenever one positions oneself in that continuum—the imagined now, some imagined past, or some imagined future—each point has a past experiential base and leads to an experiential future" (p. 2). In the pilot study, Teacher Nara, at first, made sense of how Jinmi is doing and reflected on who she is as the teacher of Jinmi by positioning herself in the imagined now. Second, she reflected on who she had been as the teacher of Jinmi by positioning herself in some imagined past. Third, she reflected on who she will be as a teacher of her future students by positioning herself in some imagined future. Nara's positioning herself in this continuum constantly awakened and transformed her identity of becoming the teacher of her students. Nara became successful in her inquiry into becoming a better teacher through our collaborative reflection. Thus, Nara's reflective experiences were essentially relational and existential experiences by positioning herself in the continuum of the imagined present, past, and future contexts through which she pursued her meaning making stories. This is the same for children. To listen to children's meaningful stories in this continuum, it is important to create the STS reflective activities and environments which empower children to position themselves actively and freely in the continuum of their imagined past, present, and future during their pursuit of meaning making stories. Thus, I also believe that the reflective experiences of all the people in a space of working with STS reflective activities includes both spatial and temporal dimensions, and the two dimensions work inseparably and interchangeably and contribute to our epistemological inquiry into the reflective experiences of all the participants with STS reflective activities.

Selection of the Participants

Jinju (pseudonym), a female Korean 5th grade homeroom teacher, and all of the thirty four students (14 female students and 20 male students) in Jinju's class were selected as the participants. 15 students (10 female and 5 male) were selected as focus group participants. The female students' names (pseudonyms) are Bin, Sora, Chosun, Seri, Somi, Sunmi, Dalai, Mina, Eunhee, and Nari. The male students' names (pseudonyms) are Taijo, Dolshei, Sangsu, Dongseo, and Gyungsu. This study was completed at Peace Elementary School (pseudonym) which is a public school since its establishment in 1931 in Korea. Peace Elementary School is located in a major city right next to Peace National Industrial Complex (pseudonym) which is mostly occupied by manufacturing factories such as textiles, machinery, eye glasses, electronics, and food. This school had about 1400 students from 1st to 6th grades during this study. Most of the children in Jinju's class lived in high storied apartments (about 20 stories) and they were busy with private learning activities both at private institutes and at home such as English, math, and Korean language. It would be interesting to westerners that running private educational institutes is a major service industry in Korea. About 2/3 of the students in Jinju's class were either going to the private institutes called 'All Subjects Institutes' which help children to raise their academic achievement tests in school or going to English institutes. About 88% of their fathers in Jinju's class belong to working class. About 82% of their mothers in Jinju's class are part-time or full-time workers and about a half of them work till late in the evening or at night. The air in the community around Peace Elementary School is severely polluted by the nearby factories in Peace National Industrial Complex.

Jinju (pseudonym), the teacher participant, was selected on a voluntary basis. She had about three years of teaching experiences at the time she engaged in this study. She had a strong Korean language arts and a little qualitative research background. Even if she was interested in STS education and children's reflection, she did not have any background in these areas. Jinju's consent form was completed on August 20, the day of our second meeting.

All students in Jinju's class were selected as participants based on the following reasons 1) that selecting student participants in schools in Korea is possible on the basis of the school principal's consent, 2) that Jinju wanted to work with all of her students as participants, and 3) that the principal of Peace Elementary School, Jinju, and I all shared the common concern that the parent consent forms which would look like an important contract form could harm both Jinju and the parents of her children in class. The main concerns of the third reason were 1) that the contract type consent form for students and parents is not used for the educational research in Korea, and it could cause an unnecessary concern to the parents in such a way that this study might be very dangerous physically or psychologically to their children and that 2) that the contract type consent form may harm the highly respected authority of homeroom teachers in Korea. Thus, I shared these concerns with my supervisors and a member of the Faculties of Education and Extension Research Ethics Board (EE REB) at the University of Alberta. As a result, I received permission for selecting all the students in Jinju's class as the participants in this study primarily based on the principal's consent form on the conditions 1) that I should receive the consent forms from the students and the parents for the students who would be heavily involved in this study and 2) I could use the data of the other students who would be less heavily involved in the study without any consent forms.

The school principal carefully read my letter, school consent form, and discussed all of our concerns regarding this study before the school consent form was completed. I put all the necessary conditions on behalf of the children and their parents in Jinju's class in the principal's written consent form. I also wrote and gave my pledge letter that I would try my best not to harm Jinju, her students, and Peace Elementary School. The principal signed the school consent form which allowed me to work with Jinju's students in her classroom from September, 5, 2003. Student letters and parents' letters were delivered to their homes explaining the purposes, procedures, data gathering methods, possible benefits and concerns, and ethical considerations before the students in Jinju's class were involved in this study.

Fifteen students were selected as focus group students on October, 26. The focus group was formed on the basis of children's own voluntary participation and our collective decision making after several weeks of careful observation and evaluation. Even if I originally planned to have four students in our focus group, Jinju strongly recommended having as many students as possible in the focus group partly because she had some students she was very interested in and partly because we were worried that we might not have rich data as we expected. After a week of negotiation, I followed her decision and started with 15 students in our focus groups—more female students volunteered than male students. Thus, both student and parent consent forms for the 15 students were delivered to their homes and returned with their names and signatures before they were heavily involved in this study.

I received two other consent forms: one from Gukhwa (pseudonym), Sora's mother, the other from Dr. Min (pseudonym). I interviewed Gukhwa to understand her experiences of being a caring mother while Dr. Min was invited as a guest to share his life experiences as a life scientist with the children in Jinju's class. Both Gukhwa and Dr. Min signed their consent forms, and they were completed before they participated in this study.

Anonymity of participants and confidentiality of information have been safeguarded at all times, since pseudonyms have been used for participants, and the name and the location of the school have been disguised in the field notes and research reports. All efforts were made to protect the identity of the participants.

STS Reflective Activities

Tensions between Theoretical Paradigm and Human Experience

Our values, especially, my values, were important and, thus, interwoven into our meaning-making stories, influencing the inquiry. However, tensions erupted between my two worldviews. On the one hand, I had a clear theoretical paradigm on how to work on teaching STS reflective activities. On the other hand, I had another clear view that I must not subjugate children's unique experiential growth to my theoretical worldview. Clandinin and Connelly (2000) pointed out that researchers should be aware of reductionism and formalism. They explained that "just as reductionism makes the whole into something lesser, sociological and political analysis can also make the whole lesser through the use of abstraction and formalism" (2000, p. 38) which obscure and formalize human experience to a great extent. This idea was particularly important in this study because this study goes further beyond the boundary of data gathering and worked on children's data generation by having them lead storied lives with STS reflective activities. Thus, there was a concern that my theoretical paradigm could misguide children's experiences in undesirable ways. It is not desirable that educators allow human experience to be totalized into a framed set by a formalistic worldview.

In this study, however, my theoretical paradigm, if used cautiously, not only can enable educators to understand and uncover the deeper meanings of children's experiences in terms of data gathering but also can guide educators to empower children to cope with their existential conditions of science and technology in terms of data generation.

My personal values, standpoints, and assumptions were stated throughout the research text, and I knew that I needed to be fully aware of my own worldviews, preoccupations, expectations, concerns, and perspectives. Thus, I tried my best to be neutral in every aspect of my engagement with children from the beginning to the end. Therefore, Jinju and I discussed any concerns about the possible misuse of our values and put them under the scrutiny of our constant awareness before the classes started and continued to be aware of the possible misuse of our values during the study. Jinju, as a homeroom teacher, was regularly informed that she should be fully aware of this idea as a main curriculum planner as well as co-interpreter. She was also informed that her engagement in teaching, particularly, in writing feedback in the students' journals might lead to conscious or unconscious, direct or indirect indoctrination without careful consideration.

Rationales

The purpose of the STS reflective approach in this study was to grow and strengthen children's moral capacity to cope with their existential conditions of science and technology. In this study, reflection does not represent intellectual skills, behaviours, or attitudes which are stimulated by reinforcements or operation, or which are forced by teachers. The result of the STS reflective approach should be a creative reconstruction of one's own moral selves based on one's personality, ability, interest, and social setting.

The value criteria of the STS reflective approach were based on essential humanistic values in the age of globalization and technology such as human dignity, dialogue, and caring and respect (for the self, others, and nature). These values should be educated not forcefully but naturally based on children's own conscious reflections through a variety of children's reflective practices.

Reflective capacity varies among individuals, develops with age, and is fostered by educationally conducive environments (Moon, 1999). This means that teaching methods and classroom environments must be conducive to each individual's age, interest, and difference.

To achieve the purpose of the STS reflective approach in this study based on the above rationales, we positioned children or ourselves in several positions. First, we positioned each child as the protagonist of their inquiry into their daily STS issues in which children freely and actively made sense of the moral issues, made the moral decisions, took the moral actions, and constructed their own meanings. Second, we positioned each child in a continuum of going between personal and social and present-past-future contexts in which they could create meaningful stories in the various relational contexts. Third, we positioned ourselves in a dialoguer's position where we attended to the unique reflective growth of each child based on children's uniqueness. Fourth, we positioned ourselves in a carer's position where we cared for all the dimensions of children's reflective growth by guiding their narrative experiences such as their emotional, aesthetic, volitional, intellectual and moral experiences. Positioning children and ourselves in several positions was our effort to provide children with a richer reflective space to create richer and more meaningful stories in expanded personal-social and past-present-future contexts. It is especially meaningful in terms of data generation because stories take on richer meaning when children create their own meanings by interacting with people and contexts intensively and extensively.

Basic Steps

Generally speaking, all children's STS reflective activities were organized into three steps: 1) exposure to reflective activities, 2) process of reflection, and 3) creation of reflective work (Smith, 1997). In the first step, we tried to present STS reflective activities that could touch children's interests, prior experiences, and creativity so that they could be actively motivated to make sense of the moral issues. In the second step, children were to delve into the STS moral issues, first, through personal reflection, second, small group reflection, and, third, whole group reflection. We tried to allow them to begin with their daily experiences and relate those not only to their personal-social contexts but also to their past, present, and future contexts. We tried to build an environment in which children's ideas, struggles, beliefs, hopes, faith, and resolutions for the self and society could be addressed and discussed in class so that children could learn by listening to others' voices, which dialectically would foster their reflective capacities. In the third step, they expressed their reflections through various means such as writing, storytelling, or artwork. They wrote reflections for each of their work through personal and group reflection and presented most of their work in front of the whole group. However, it must be noted that the actual process of reflection was different from one activity to another and that children's reflection happened at any time of their learning.

Credibility

Credible Data

The credibility of data leads a researcher to construct credible themes and plots, empowering the researcher to create credible cohesive stories and, thus, meaningful analysis and interpretation must be grounded in credible data. In judging the credibility of narrative analysis, Polkinghorne (1995) pointed out that "a distinction can be made between the accuracy of the data and the plausibility of the plot" (p. 20). The term, accuracy of the data, assures whether the reported events actually happened, and it depends on researchers' persistent attention and sensitivity to the events by using a variety of appropriate data collection methods.

For Jinju and me, this study lasted from August 20, 2003 to January 07, 2004 while, for the children, it lasted from September 6, 2003 to January 07, 2004[10]. Children worked on their STS reflective activities from September 23, 2003 to December 30, 2003. The data collected in this study were from stories (children, the homeroom teacher, Sora's mother, Dr. Min, and the researcher), everyday conversations, observations, class recordings, interviews, field notes, photographs, researcher's journal as well as student journals, children's work (drawings and writings), and pre-and post-study questionnaires (children only), and personal letter (children only). To achieve data, I observed every lesson, recorded field notes, and had conversations with children on both formal and informal bases. Jinju and student participants were audio-recorded and sometimes photographed during the lessons. In addition, the everyday conversation with children was recorded, if necessary. All the participants had an opportunity to rethink and revise what they said. Final interviews were completed based on informal interview with each child and the teacher respectively. Through these audio-recorded interviews, I explored how this study affected each of the participants including the teacher. I also observed the daily lives of the 15 students in our focus group whose stories are heavily described in this study because it was more desirable to collect data not only from the children but also from the people and the contexts in which they interact in order to understand the children's whole life.

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[10] In Korea, the whole academic year starts in March. The second semester usually starts on the first day of September after about 40 days of summer vacation.

Pre-study and post-study study questionnaires were developed by Jinju and me and completed as supplementary methods of data collection. Pre-study questionnaire was particularly useful in understanding how children perceive science and technology before they engaged in the study, and it helped us to construct better STS reflective activities (See Appendix 1). Post-study questionnaire was developed by Jinju and me in order to evaluate our teaching in a third person's position (See Appendix 2).

However, data alone cannot make up a story because a story becomes significant when it tells meaning. Carter (1993) explained that "story becomes a mode of knowing when it captures the richness and the nuances of meaning in human affairs" (p. 6). The richness and the nuances of meaning, in turn, depend on the richness of the data, a researcher's sensitivity and creativity to the happenings and events, which are central to the construction of a meaningful plotline. It was possible to achieve the richness of the data because Jinju and I provided children with STS reflective activities and environments in which each child could tell of their storied life as I addressed earlier in this chapter.

For the issues of the researcher's sensitivity and creativity, I paid attention to several aspects as a qualitative researcher. First, I became an insider in the classroom through substantial engagement with the participants in order to capture credible data. I lived in the classroom community for the entire school day at least three days a week to develop an awareness of the people, contexts, events, and interactions about a month after this study began. Jinju and I observed and talked with children long enough to understand their experiences in relation to the contexts they were situated in. Second, we also created safe and comfortable environment through space and time so that children could tell their stories as frankly and freely as they could. Jinju and I reminded the participants that we did not want to listen to any kind of affected attitude to soothe the researcher or the teacher. We also did our best to teach as fairly as we could. Third, I reflected on our developing constructions and documented the process of change from the beginning until the end of the duration of the study. Fourth, I verified with the participants the constructions that were developing as a result of data created and interpreted. For example, at the end of my informal conversation with a child, I summarized the created data and asked if the notes accurately reflected the child's ideas. Fifth, our collective analysis and interpretation were based on many different data mentioned above. Sixth, the data was documented and reflected upon on a daily basis and analyzed and interpreted on a regular basis by Jinju and me in order to seek deeper meaning and better teaching methods throughout the study. As a summary, the credibility of the data in this study encompasses the accuracy, the richness of the data, and a researcher's creativity and sensitivity to the happenings and events.

There were a few problems too. First, it was hard to find my space in Jinju's class for about a whole month during the first part of this study partly because Jinju felt quite uncomfortable with showing her class to a strange researcher and partly because she was afraid of losing her authority over me. I wanted to ask for more help from her, but I did not because of the concern that my push would disturb Jinju's teaching. I also felt we could not exchange our journals at all because she felt so hesitant in showing her writing to me. These aspects affected this study negatively in that we could not understand each other's progresses well enough for the whole month during the first part of this study.

Plausibility of the Study

Polkinghorne (1995) explained that the threaded themes are called the plot, and when events and happenings are configured, they take on narrative meaning. Polkinghorne (1995) further explained that "texts are thematically composed by plots" (p. 5). It must be noted that the meanings of this collaborative narrative inquiry are the meanings of our collaborative narrative experiences. Thus, creating plots was based on our collective analyses and interpretations of the happenings and the events that were meaningful to our lives both as a teacher and a researcher. Connelly and Clandinin (1990) highlighted that the coherence of the generated story among the situated, contextual, and particular elements of the data provides its explanatory power. In this study, working on STS reflective activities provided a space where all the participants addressed their constructions of moral selves in relation to their existential contexts, providing a meaningful cohesiveness. Elements such as happenings and events were selected and interwoven based on this cohesiveness.

In interpreting storied accounts, Clandinin and Connelly (1988) emphasized the importance of "exposing the perspectives, intentions, and preliminary conceptions of the interpreters" (p. 273). As a main interpreter, all of the above conditions are expressed throughout the study, and Jinju's perspectives, intentions, and preliminary conceptions are also expressed in the next chapter. The degree of our collective interpretation was made based on our collective interpretive logic constructed through negotiation. Each other's purpose, assumptions, conceptions, and standpoints were thus negotiated, subsequently creating a shared interpretive logic, the process of which is also written from now on in the research text. In this study, the analysis and interpretation of all the data were constructed collaboratively by Jinju and me throughout the study. I had about 40-60 minute conversations with Jinju after each STS reflective activity through which we shared ideas on constructing lesson plans and explored the experiences of teaching STS reflective activities. These regular conversations were audio-recorded to capture the conversations wholly and accurately. Jinju and I reviewed and clarified the original data as well as its analysis and interpretation used for any research text composition. Phone conversations were conducted and emails were exchanged after leaving the field till the completion of this study to compare each other's perceptions. Through this process, I clarified the meaning of the data and co-constructed interpretations while I was solely responsible for text composition. In addition, I tried my best to balance our collective standpoint at every facet of research by monitoring to ensure that our relationship was built on trust, negotiation, cooperation, compromise, and sharing authority.

Persuasiveness is also an important criterion of plausibility (Polkinghorne, 1995; Clandinin and Connelly, 1988). This implies that the capacity of the generated story should enable the readers to feel the insight and resonance in their contexts. Clandinin and Connelly (2000, p. 131) explained that "narrative inquirers constantly need to pay attention not only to character, place, scene, plot, tension, end point, narrator, context, and tone, but also to the questions of meaning and social significance to create persuasive stories for different readers." The issue of persuasiveness resonates with the question of "how can we create meaningful stories by keeping faithfulness to the credible data?" This question is personally the most important responsibility bestowed on me, as a novice narrative inquirer.

In summary, the credibility of the generated storied accounts consists of a) credible data: accurate data, richness of the data, and the researcher's sensitivity and creativity to events and happening, b) meanings of our collaborative narrative experiences as a teacher and as a researcher, c) collective interpretation based on our shared interpretive logic, d) coherence among the situated, contextual, and particular elements of the data, and e) persuasive capacity that enables the readers to feel something intelligently, emotionally, aesthetically, and morally.

CHAPTER VI

Stories of Working in a Space of STS Reflective Activities

Entering a Place of Hope: (8/17-9/15/2003)

I was originally supposed to work with another female teacher in a different school, but she notified me that she would not be able to work with me because of the large amount of school duties she was assigned by the school on August 10, 2003. Jinju was introduced to me by one of my colleagues a week after this incident. The only fact I heard from my colleague was that Jinju had a very professional and caring spirit as a teacher. We first met at a restaurant near the university we graduated from on a rainy night. After exchanging our wonders, concerns, hopes, and purposes for this study, I knew myself feeling safer by confirming the facts my colleague talked about Jinju. We shared common feelings that moral education should be taught in such ways that moral education should be something children could feel from their hearts rather than thinking from their brains, and that moral education should attend to children's differences. Above all, it seemed lucky to me because I confirmed her professional and caring spirit while exchanging our personal experiences as teachers. She was attending graduate school at a university. She said that the main reason she was attending graduate school was to teach her students better in class, not to achieve a master's degree only. She also found herself happy the most with her students even if she was busy preparing for all kinds of school activities such as athletic festival or art festival. She said she simply liked those activities too because she was enjoying being with children.

The purposes she brought into our space of working with STS reflective activities were threefold (Researcher's Journal, 08/17/2003). First, she wanted to provide her children with a meaningful experience irrespective of the topics. She said she used to do many kinds of project teaching and always found them useful to her children. Thus, it was not surprising that this study became one of the helpful sources as part of her project teaching practices. Secondly, she wanted to learn how to construct effective teacher-based school curriculum. She said she was dissatisfied with the fixed school curriculum, but she said she did not seem to have sufficient capability to construct effective teacher-based school curriculum. Third, she wanted to learn how to conduct a qualitative research better. She was supposed to write her master's thesis by using qualitative method and found this study as a helpful source.

As a result of our week long negotiation on the issues of each other's purposes and agendas, we were able to develop our research cycle of teaching STS reflective activities: co-curriculum planning, data generation and collection, and co-reflection and interpretation. We decided to complete one research cycle for each STS reflective activity. Even though we decided to work together in every aspect of the research cycle, we took different roles in two ways. Jinju was solely in charge of all teaching activities while I was mostly in charge of children's data collection (See Appendix 3 for the research time table).

However, I did not negotiate two issues. First, I did not fully negotiate the exact process of my observation. Second, I did not ask about my space in her school. My lack of consciousness on these two issues led to a great difficulty during October. I also had to make a compromise to start our first lesson on September 23 because she was extremely busy preparing for the school athletic festival even though I was allowed to have the access to

Jinju's children from September 5[11]. In the meantime, we co-constructed STS reflective activities and organized them into the existing curriculum, although the actual practices of STS reflective activities were changed based on the negotiations of the ideas, roles, and difficulties newly developed in our shared journey of working with STS reflective activities.

Pre-Study Questionnaire (9/6)

The first puzzle Jinju and I met was how to understand children's background of science and technology in order to construct STS reflective activities. As a result, we reached an understanding that a pre-study open-ended questionnaire was the best choice based on two distinct ideas. One was that children could write as freely as possible without any stress of meeting a strange interviewer at the beginning. The other was that interviewing 34 students would require a large amount of time which might bring about undesirable harm to both children and Jinju. We developed a pre-study open-ended questionnaire and had it completed by the entire class on September 6, 2003. The followings were some important ideas we got from pre-study open-ended questionnaire.

The first question was, "When you think about science and technology, what words do occur to you? You can write invisible things or concepts too. Please circle the words which can be used in wrong ways."

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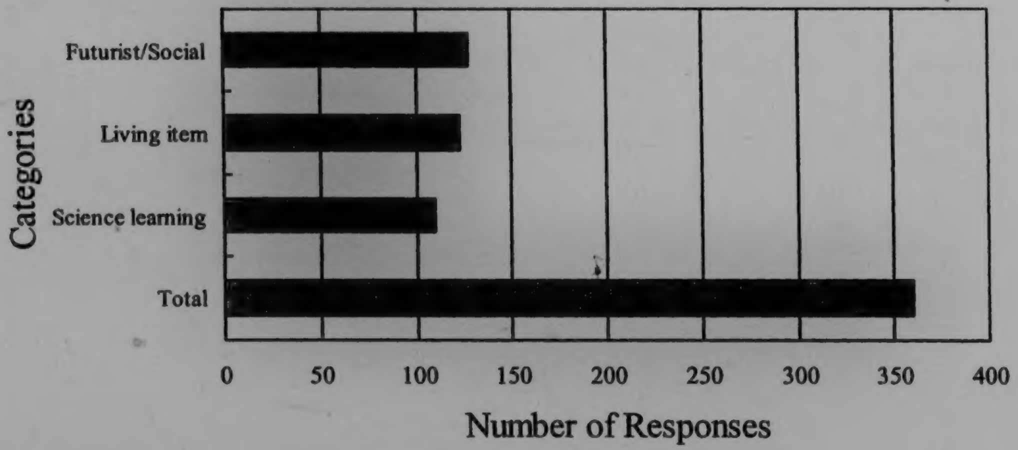
[11] School athletic festival is probably the most major school event throughout the whole academic year in Korean elementary school setting. Schools usually spend a few weeks for the preparation for it and teaching periods are usually shortened for children's practices during this period.

Figure 4. Results of children's responses to Question 1



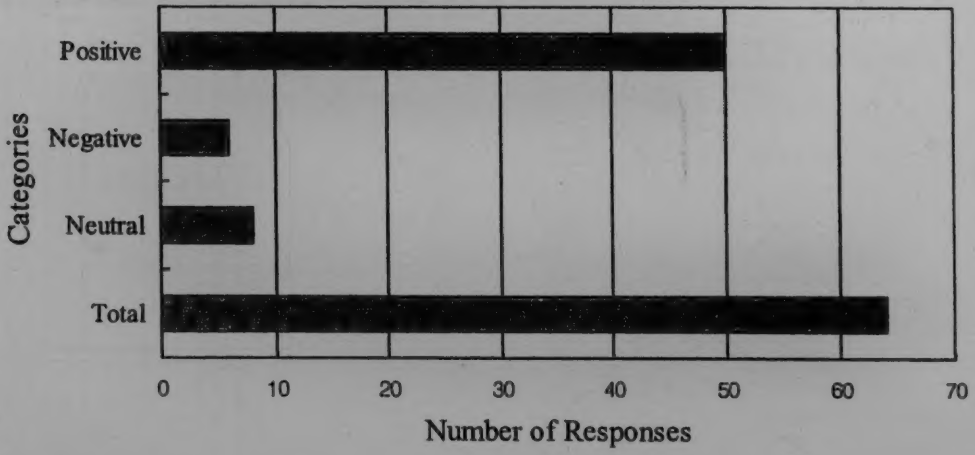
Notes.

1. The number of children's responses does not represent the number of children.
2. Futurist/Social includes the words such as development or future/factory or credit card.
3. Science learning includes the words related to science class or science reading such as experiment, science room/ Einstein, Nobel.

As shown in Figure 4, the responses were categorized into three groups: Futurist/Social, Living item, and Science learning. The first impression we had was that children related science and technology to futurist or social, living item, and science class or science reading. Secondly, we found that, in Futurist/Social category, most of the responses (92/127) belong to 'futurist' suggesting that children tended to relate science and technology to 'development' or 'future' rather than other social dimensions. Jinju immediately presumed that futurist orientation was the main topics children usually met in their textbooks and in various kinds of science competitions held in and outside of school. Thirdly, we found that only 6.94 % (25/360) of the whole responses were circled as harmful such as atomic bomb, war, and gas stove. So, we judged that 1) the children's concepts about science and technology are closely related to living items, science learning, and futurist orientations and 2) children tend to see science and technology in a more positive way (See Appendix 4 for the comparison of children's responses to Question 1 between pre-and post-study questionnaires).

The second interpretation, 'children tend to see science and technology in a more positive way' became clearer when we analyzed the third question which stated, "Write the images, feelings, or thoughts when you hear about science and technology in full sentences."

Figure 5. Results of children's responses to Question 3



As shown above, children's responses are grouped into three categories: Positive, Negative, and Neutral, and most of the children's responses belong to Positive (50/64). We also made four subcategories under Positive. They are Develop Better (19), Helpful (16), Advanced Technology (8), and Korea's Growth (7) (See Appendix 5 for the comparison of children's responses to Question 3 between pre-and post-study questionnaires).

Question 4 and 5 were 'Yes' or 'No' questions. Question 4 was, "Have you thought whether you are using science and technology in a right or wrong way?" In Question 4, only four children (11.76%) children circled "Yes." Question 5 was, "Have you thought whether adults are using science and technology in a right or wrong way?" In question 5, only 8 children (23.52%) circled "Yes" Therefore, we judged that the majority of the children had not consciously thought whether they or adults use science and technology in a right or wrong way. Accordingly, we made three basic interpretations based on our analysis of pre-study questionnaire that 1) children's concepts about science and technology were closely related to living items, science learning, and futurist orientations, 2) children tended to see science and technology in a more positive way, and 3) the majority of the children did not consciously think about whether they or adults would use science and technology in a right or wrong way.

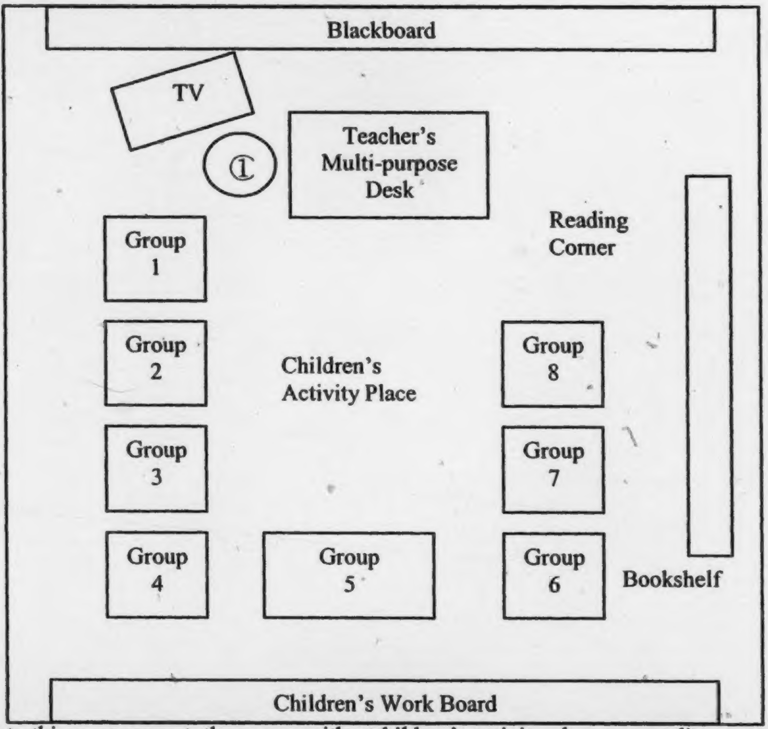
Based on the above interpretations, Jinju and I reached an agreement to construct our STS reflective activities to 1) enable children to be sensitive to the STS issues particularly in their daily life, 2) balance both the positive and negative aspects of science and technology. We also agreed to be neutral while teaching STS reflective activities in every aspect of class activities such as lessons, conversation, and verbal or written feedback because the primary focus of this study was to attend to children's individual moral growth.

Curriculum Planning and Organization (8/20-9/22)

Jinju and I worked closely together in developing various STS reflective activities, organizing them into the existing curriculum, and developing teaching strategies. We met eight times for about a month. Some of the activities originally came from my ideas, and some, from hers. We co-constructed many aspects of each activity through cooperation and negotiation. The STS reflective activities were composed of three aspects: reflective environments, STS reflective activities indirectly related to children's daily experiences, and STS reflective activities directly related to children's daily experiences.

Building conducive reflective environment was the fundamental dynamic of children's reflection. I show a simplified map of Jinju's classroom to explain our reflective environments.

Figure 6. Simplified map of Jinju's classroom


Blackboard
TV
①
Teacher's Multi-purpose Desk
Reading Corner
Group 1
Group 2
Children's Activity Place
Group 8
Group 3
Group 7
Group 4
Group 5
Group 6
Bookshelf
Children's Work Board

Note. Prior to this arrangement, there was neither children's activity place nor reading corner. Besides, the children's desks were positioned in favour of teacher-centred activity in the traditional classroom.

In terms of creating reflective environment, we first focused on building a caring relationship between a teacher and children. In order to attend to children's individual personalities, abilities, interests, and other differences, Jinju suggested we reorganize the traditional classroom into a more dialogical classroom. This dialogical classroom provided a space in which children could not only work closely with one another but also get easy help from Jinju. We grouped four children (six children in Group 5) into one group and, thus, formed eight groups altogether. As shown in the picture, we created a children's activity place at the centre where they always presented their materials, listened to stories, and did whole group reflective discussions. ① stands for Jinju's portable chair on which she delivered storytelling. Jinju used her encouragements, praise, and feedback for children's reflection easily in this dialogical classroom, and she also concentrated on using feedback, particularly for children's STS journals. As Carl Rogers (1994) pointed out, children are constant seekers of carers who can help them to grow out of their genuine learning desires and this classroom design helped Jinju to transform her paradigm on teaching from seeing a child as a vacuum to be filled with the learning she already set to seeing each child as a whole learner. She said:

> I found a big difference when I became interested in the single word or the single picture of each child and gave my feedback. They do well. That's because I felt different when I got their work back. It was different between when I saw their work as usual [at my desk], and when I saw their work by touring the class. You know I could see that I became once again interested in their work, and I could see the way they have gone through in terms of thinking process. I saw that! I felt the way they thought once again. When I let them do by themselves, their work is just theirs. But by sharing and talking, their work was not just theirs but mine too. By doing this, I expand my sharing with them and I've come to know who they really are, how they think… This way I expand my understanding of seeing children… (Interview, 12/30/2003)

Second, we used some specific methods such as reflective post-it for other's work,*[12] and cooperative work* as well as individual, small group, and whole group discussion both intensively and extensively to foster children's reflective interactions. Using post-it was very useful as a way of fostering children's interactive reflection. Whenever children's work was posted on the children's work board at the back of the classroom, each child was required to see other's work, receive one post-it, write her or his reflection for others' work, and mount it on the work she or he was most interested in. It is natural that children became more interested in seeing others' reflections on their own work, and reflective post-it helped them to foster each other's reflection in this way.

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[12] * indicates that these reflective activities originally came from Jinju.

Third, STS issues meetings were held on every Wednesday and Saturday[13] after October 27th on a voluntary basis. During the meeting, Jinju led a reflective discussion in which children actively addressed their STS issues they were facing in everyday life.

Fourth, STS reading corner*[14] was built in order to provide a reading space in the classroom. We bought 15 books related to STS issues. The books were introduced to children one by one by Jinju to encourage their reading. The titles for some of the books were: Science and Invention, Children Ask and Nobel Prize Winners Answers, History of Books and Printing, Internet World and Democracy, Hidden Stories of Great Scientists, The Greatest 100 Inventions in Human History, and History of City Development. Children were also encouraged to use the school library which was located right below Jinju's classroom. Besides, children also brought their own good books from home to provide other peers with an opportunity to read those books on a voluntary basis. Jinju also gave STS reading awards to the children who completed reading ten science books. 15 children got their awards, and seven of them continued their readings and went beyond reading twenty science books without any more incentives.

STS reflective activities which were indirectly related to children's daily experiences were Nobel's biography, Sadako Sasaki's story, a video clip on cattle dung beetle, interview with a life scientist, and science fiction writing*[15]. These activities were developed to expand children's reflection into a more broadened socio-historical dimension so that they could be able to make sense of the important STS topics they could hardly recognize in their daily life settings. Some of the possible questions raised from the topics by children themselves were: what it is like becoming a scientist or a technologist; what scientists and technologists should do for the self, others, and nature; how scientific research affects people and nature; and how wars are related to the misuse of science and technology. In this way, children could position themselves in a wider socio-historical dimension and reposition themselves back in their daily lives with a broader understanding.

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[13] Korean students go to school on Saturdays, but they come home early after finishing morning classes on Wednesdays and Saturdays.

[14] * indicates that these reflective activities originally came from Jinju.

Reflective activities which were directly related to children's daily experiences were brainstorming, planting garlic,* interview with parents (how technology has changed our lives), participatory inquiry (into technologies in our community), Netiquette,* cooperative artwork (our ideal community),* STS journal writing, and STS practice journal writing.* These activities, particularly STS journal writing and STS practice journal writing, played a pivotal role of children's active meaning making through reflection in this study.

It must be noted that many aspects of the original curriculum planning we constructed were reconsidered and modified as we progressed throughout the study, and some of the STS reflective activities were developed in the middle of our progress by Jinju such as Netiquette, science fiction, and STS practice journal writing.

The lessons of STS reflective activities were organized into the following subject areas: moral education (1), social studies (4), science (5), practical practices (1), art (2), language arts (6), computer (2), and teacher's discretional lessons (2).[16] The organization of STS reflective activities in the 5th grade school curriculum is shown in Table 1.

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[15] * indicates that these reflective activities originally came from Jinju.

Table 1.

Organization of STS Reflective Activities in the 5th Grade Curriculum

STS Reflective Activity	Subject	Date	Period	Minute
Brainstorming	TDL*	Sep. 23	2	80
Interview with Parents	Social Studies	Oct. 16	2	80
Video Clip on Cattle Dung Beetle	TDL	Oct. 23	2	80
Sadako Sasaki's Story	Moral Education	Nov. 10	2	80
Netiquette	Computer	Nov. 20	2	80
Participatory Inquiry	TDL	Nov. 22, Dec. 16	3	120
Interview with a Life Scientist	TDL	Dec. 13	1	50
Science Fiction Writing	Korean	Dec. 16	2	80
Cooperative Artwork	Art	Dec. 27	3	120
Nobel's Biography**	All Subjects Above	Sep. 23 – Dec. 29	11	190
STS Journal **	Individual Work	Sep. 22 – Dec. 26	.	.
STS Practice Journal**	TDL/Individual Work	Nov. 28 – Dec. 24	1	40
Planting Garlic**	Science/ Group Work	Sep. 30 – Dec. 30	2	80

Note.

5. * indicates Teacher's Discretional Lessons (TDL) and the curriculum contents of TDL is organized based on a homeroom teacher's wish, need, or specialty.
6. ** stands for a longitudinal STS activity. The other activities are single STS activity.

First, Nobel's biography was divided into ten chapters and each chapter was read to the students at the beginning of every other single STS reflective activity for about 15 minutes throughout the whole study. Second, STS journals and STS practice journals were completed based on each child's own progress. Third, we used one period of TDL class to have children make their own STS practice journals. Fourth, we also used two periods of science class to have children plant garlic, and they continued to observe and raise their garlic until the last day of this study.

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[16] The number in parenthesis is the actual number of the teaching periods of 5th grade curriculum subjects per week (40 minutes per period). Four other curriculum subjects, Math and P.E., music, and English were excluded from this study. Teacher's discretional lessons were the main space for our reflective activities.

As soon as a reflective activity was completed, Jinju and I got together with all the children's data. Jinju shared her reflective analysis and interpretation on children's reflection as well as hers mainly based on her specialty in knowledge on the individuals, contexts, and the interactions, and curriculum planning while I shared my reflective analysis and interpretation mainly based on observation and individual conversation. Thus, we continued to shape and reshape the following reflective activities based on our shared analyses and interpretations we made from the previous reflective activity throughout the whole study.

Moment of Happiness in Jinju's Class (9/15-9/30/2003)

The school athletic festival was finished on September 15, and Jinju finally allowed me to observe her class next day. My first impression, when I entered the class, was very encouraging because I could feel liveliness on everyone's face. When I was introduced to the class, children seemed quite puzzled but curious about my presence even if they were lively enough not to calm down during my speech.

Children usually arrived at the school around 8: 30 in the morning. The first thing they did upon arriving was to take a glance at the blackboard to check what they should do before the first class started. Jinju provided children with a variety of topics to work on such as writing assignments, preparation for tests, artwork, and drawing. Of course, the most exciting topic should be 'free time.' During their class time, children seemed free to move themselves to any places they wanted to go, and I saw some children studying while sitting on their desks. An interesting regular event, however, happened right after their morning class while a few children were preparing for their meals provided by the school. As soon as Jinju turned on a wide screen TV, children started to move their desks back and stood at the center in the classroom. When the animated dancer on the TV screen said, "Let's dance," children started Hip Hop dancing by following the dancer's direction. When the meals were finally ready, children were asked to move their desks back and be ready for their lunch. In Korea, every elementary school has a cafeteria in which lunch meals are cooked and delivered to each class for every student. After finishing their lunch, some children usually went outside to play. As soon as they moved, every corner of the school became crowded. Many of the boys liked to play soccer. The girls liked to play traditional Korean playthings both inside and outside of their classroom. They tended to change one traditional plaything to another as the season changed. However, many of the children preferred staying inside the classroom and spent their time in reading, studying, playing, or talking to each other.

After class, a few children always stayed in Jinju's classroom. They usually played go or traditional chess, used Jinju's computer, and enjoyed talking each other or Jinju. It was a real happy moment to see that Jinju was always smiling at these children and enjoyed being with them. Even if the presence of the children disturbed her busy school work, she was generous enough to provide the children with a happy space. Jinju often gave them something to eat, played with them, and oftentimes made a big laugh. I became more impressed when I found that those children who used to stay in the classroom were either the children whose parents came home late in the evening or at night or the children who could not afford to go to private institutes. For those children, there were no people at home who could take care of these children after school.

However, Jinju often made uncomfortable faces when children became too noisy in the class, and she frequently said she was sorry for showing the noisy class to me. She seemed to be afraid of showing her noisy class. It was natural for the children to be noisier than usual right after their school athletic festival because, during the school athletic festival, children had already became used to enjoying the frequent absence of their homeroom teacher who was busy with preparing for all kinds of athletic activities. Homeroom teachers in Korea feel the similar concern of controlling their wild children as a customary aftermath of the school athletic festival. I frequently told Jinju, "My presence in your classroom is not and will not be an evaluator of your lesson implementation at all. I am here to see how children do." But I could hardly see Jinju's bright safe face after she was perplexed about showing her noisy class. I took her response as a temporary phenomenon of discontinuity which I had faced just for a few days in Nara's class in my pilot study. Nevertheless, my happy memory of having a caring teacher as my research partner lasted until we finished the two STS reflective activities: brainstorming and planting garlic.

Brainstorming (9/23)

The purpose of brainstorming was to provide a reflective space in which children sensitize themselves to a variety of STS issues affecting their lives.

Individual and Group Reflection

After a brief introduction, Jinju initiated brainstorming by having her children write any words occurring in their minds when they thought about science and technology. She continued to say, "I will give you 15 minutes. Please write any words which are related to science and technology. You can write things, concepts, or whatever is occurring in your mind… home, in school, or in society" (Class Recording, 9/23/2003). Children were encouraged to write as many words as they could.

However, it was not long after she initiated this activity that she had to answer children' frequent questions. Some examples were, "Teacher, is it all right to write invisible things?" "Teacher, can I write 'fan'?" "Teacher, can I write all things in my mind?" Those children seemed to be afraid of writing wrong answers because they were accustomed to writing a single right answer in their usual practices of learning. Jinju followed those questions by saying, "Don't worry about whether they are wrong or right. Just write whatever is occurring in your mind as freely as you can." Then, Byungsu suddenly got everyone's attention by saying, "Teacher, a person is technology too." Jinju said, "Why?" Byungsu drove the class into a big laugh by saying, "A baby cannot be delivered without cutting its mom's belly." After a while of big fuss, Jinju replied, "That is a good idea. Then, what technology would be used for the operation." Dalai said, "Caesarean operation." Jinju went on to say, "Good. Why don't you write it, Byungsu?"

Fifteen minutes later, the class activity was shifted from personal reflection to small group reflection. Reflection in small groups was helpful in that children could develop their simple understanding they made in an isolated situation further into a more expanded understanding by comparing others' reflections with one's own. After distributing eight big carbon papers to each group, Jinju said, "Now, you need to classify. You must put what you have written in the three categories, 'Society,' 'Home,' 'School.' Don't even try to draw nicely." Jinju also had the children circle the words that could be used negatively with red markers. 'Society' was added as a category to expand their understanding of science and technology into a more social dimension because they did not expand as such in pre-study questionnaire. Children's drawing red circles was introduced to give children an opportunity to balance both the positive and the negative aspects of science and technology based on our judgment on the analysis of pre-study questionnaire.

Most of the time, I observed the children in Group 7: Jaemin, Junsu, Byungsu, and Dalai. As soon as the children moved from individual reflection to small group reflection, Dalai became responsible for rewording all the words of each student on the big carbon paper. They discussed issues with one another such as 'what category each word would belong to' and 'what word they would circle with a red marker.' I saw they went through a few times of serious disputes on these issues. We presumed that classifying what they had written in any manner they pleased during their individual reflections was not an easy job in small group format because it required cooperation and negotiation to reach a consensus among them. But by going through classifying every word they wrote one by one, the children in Group 7 carefully examined not only what technology they were exposed to but also whether they could be used in wrong ways. They finalized their presentation material as below:

> Home:
>
> > Calculator, house, desk, chair, delivery, TV, DVD, computer, paper, electricity, doll, book, car, bag, telephone, gas stove, washing machine, fan, air-conditioner, glasses, lens, heater, notebook computer, radio, audio recorder, printer, bed, closet, mirror, video recorder, ballpoint pen, knife, scissors, watch, bankcard, light stand, plug, X box.
>
> School:
>
> > Fan, air-conditioner, computer, TV, desk, coating machine, desk, copier, heater, locker, electricity, paper, book, telephone, blackboard, organ, soundproofing wall, ventilator, outlet, plug, power point presentation.
>
> Society:
>
> > **Nuclear bomb, bomb**, airplane, train, concrete [concrete structures], Miracle of Han River [the symbolic expression of the economic miracle in Korea], theory of relativity, miraculous economic growth, invention, artificial sun, cloned human, rubber, **dynamite**, radium, radioactivity, fax, cell phone, spaceship, escalator, engine, factory, **gas**, key, lock, petroleum, cash machine, paint, textile, Internet, coal, credit card, signboard, public phone, phone card, copier, paper cup. (Children's Work, 9/23/2003)

Note: Words in bold stand for the words circled red by the children in Group 7 as science or technology that can be used in wrong ways.

The children in Group 7 wrote 97 words in total, and it is interesting that 87.62% (85/97) of the above words were different from their responses to Question 1 in their pre-study questionnaires—Question 1 was, "When you think about science and technology, what words do occur to you? You can write invisible things or concepts too. Please circle the words which can be used in wrong ways." It was particularly noticeable that even if some words such as theory of relativity were not directly related to social issues, these children related science and technology to social issues more than they did in pre-study questionnaire.

However, as shown in bold, they did not make sense of the negative aspects of science and technology. They only circled four words which could be used in wrong ways: nuclear bomb, bomb, dynamite, and gas. This trend happens to the other groups in similar ways as shown below.

Table 2.

Results of Children's Small Group Brainstorming Activity

Group	Home	School	Society	Total	Red Circling
1	30	29	27	86	3
2	24	16	11	51	1
3	41	23	39	103	2
4	39	26	26	91	4
5	43	29	38	110	3
6	57	19	52	128	6
7	**38**	**21**	**38**	**97**	**4**
8	36	32	14	82	1
Total	308	195	245	748	24

As shown above, only 3.20% (24/748) of children's responses were marked as the words which can be used in negative ways in small group brainstorming while 6.46% (25/360) of children's responses were marked in pre-study questionnaire. We presumed that this percentile decrease may be due to the fact 1) that children were provided more space in brainstorming, which enabled them to find more positive aspects of science and technology than they did to Question 1 in pre-study questionnaire and 2) that children were asked to write words based on the already built categories. However, one thing seemed clear. Children were not able to find more negative aspects of science and technology despite their intensive individual and group reflections, implying that children's individual and group reflections did not lead them to make sense of the negative aspects of science and technology to a larger extent.

Whole Group Reflection and Jinju's Reflective Guidance

The small group reflection of classifying words into the three categories was shifted to a whole group reflection in which children were asked to present their work in front of the whole class. Reflection in a whole group was helpful in that children could develop the collective understanding they made in small group into a more elaborate understanding by comparing their work with others. Three groups altogether were selected to present what they did in small group format for each of the three categories: first group for Society, second for School, and third for Home. During the presentations of the three groups, the rest of the children were asked to write the words which were not recorded on their own materials. The children in Group 7 presented their work for 'Society' in front of the class and the following was the dialogue exchanged after Group 7's presentation:

Dalai (F): In 'Society,' we have nuclear bomb, bomb, airplane… Among these we marked 4 things red… [Dalai is the presenter in Group 7.]

Teacher: Why did you put 'nuclear bomb' there?

Jaemin (M): We put it because Japan was hit by a nuclear bomb. It was 1945. [Jaemin is one of the children in Group 7.]

Teacher: Why did you put gas then? ...

Jaemin (M): Well, because it can be dealt with by people wrongly. [In Korea, many people still use portable gas tanks to cook, which sometimes leads to an explosion.]

Teacher: (To the class), do you know 'Sangin Subway Gas Explosion' which killed over two hundred people in our city a few years ago? It can be so dangerous when it leads to an explosion…

Teacher: (Looking at the whole class), can you find any words dangerous but aren't circled red in Group 7's work?

Hyunho (M): Air-conditioner! [Hyunho is a student in Group 6.]

Teacher: Air-conditioner. Why is it dangerous?

Hyunho (M): If we turn it on for a long time, it causes a bad air and causes harm to us. [In Korea, we close all the doors and windows when an air-conditioner is turned on to save energy, but most of the houses do not have a ventilation system.]

Teacher: **Oh. That's a good idea. Is there anybody who has other reflections?**

Jaisun (M): If we turn an air-conditioner on so long, Freon gas comes from it and goes up in the air, and destroys ozone layer. Because of that, the ultraviolet rays from the sun come down on earth and cause skin diseases. …

Teacher: Any other reflections?

Chulsu (M): It causes global warming. If icebergs and glaciers melt, it can sink island countries like Japan. (Class Recording, 9/23/2003)

Note:

1. (M) stands for male children while (F) stands for female children.
2. Teacher's repetitive words such as the ones in bold are sometimes shortened to the ones in italic as shown above in case they have negligible contextual relations to children's words because they tend to be wordy and the readers may have a difficulty in reading the thematic flow of the discussion.

As shown above, Jinju encouraged children's discussions in two ways. First, Jinju focused on extracting the unique ideas from the Group 7 such as the words, 'nuclear bomb' and 'gas,' so that the rest of the children could reflect on how these two words are related to the negative aspects of science and technology. Second, Jinju focused on extracting the ideas from the whole class to provide a better reflective space in which children could find other possibilities of the negative aspects of science and technology and lead to a more expanded and detailed reflective discussion. It is interesting that Jinju mostly asked concrete questions by using a 'what' type question first to extract ideas from children. After that she expanded their reflections by asking 'why' type question. For example, to extract ideas from the whole group, Jinju first used a 'what' type question by asking "can you find any words dangerous but aren't circled red in Group 7's work?" When Hyunho said, "Air-conditioner," Jinju used a why type question and then asked other reflections from the children. In this way, she was not only able to extract several negative aspects of air-conditioner but also able to help the children to make sense of those negative aspects as personal, social, or global issues such as bad air, destruction of ozone layer, skin diseases, and global warming.

When the presentations of all three groups were finished, Jinju asked, "Is there something you have learned from this activity? Children's subsequent answers were followed as below:

> *Minseok (M):* I didn't know we had so many things about science and technology.
>
> *Jaemin (M):* I thought the development of science and technology has a limit, but I now think that their development seems unlimited.
>
> *Hansu (M):* I've come to know how science and technology affects us.
>
> *Sungju (M):* I've come to know a variety of technological merchandise.

> *Sangmin (M):* I've come to know that science and technology do us harm sometimes even if they do us good in many ways.
>
> *Jaemin (M):* I've come to know that if we used science and technology in bad ways, they can destroy our earth. (Class Recording, 9/23/2003)

As shown above, after the whole group reflection, some of the male children became more sensitive to the influences of science and technology and, thus, expanded their understandings a bit far into a larger context. As Moon (1993) suggested, children's reflection was more successful with the help of teachers' guided efforts in this study. As a result, my observation for this activity provided me with an opportunity to confirm how much children's reflective capacity could be improved with the careful guidance of teachers.

I also had to face an unexpected phenomenon that male children dominated the whole group discussion and contributed more substantially than female children did during this activity. Even if gender was not part of the research questions in this study, I became attentive to, and interested in, gender issues more and more as the study moved on.

Planting Garlic (9/30-12/30)

The purpose of this reflective activity was to provide children with a reflective space in which they come to know how environmental pollution affects the growth of garlic and to respect and care for our nature, particularly, plants. During this activity, we had to overcome a difficulty in dealing with some science contents as non-experts in science as Marker (1993), a social studies STS scholar, pointed out.

Our Struggle with Scientific Knowledge

It was our second meeting that Jinju and I discussed some possible activities of children's reflection on nature (Researcher's Journal, 8/20/2003). She suggested that children could plant their own seeds and raise plants throughout the whole semester. However, we had a hard time with what plant we should choose and how we should relate children's reflection on raising plants to the existing science curriculum. It took about two weeks before we settled with those issues. At the beginning, we chose barley, but we were not quite sure whether it could continue to grow well until the end of December during the winter season. So, I discussed it with my maternal grandmother who had been a farmer for her lifetime. She recommended that we grow garlic rather than barley because it would grow bigger than barley and, thus, more noticeable to children's eyes than barley. I confirmed my maternal grandmother's suggestion with Dr. Min, my friend, who participated in this study as a life scientist working at one of Korea's national institutes of agriculture.

However, the issue of how we should relate children's reflection on raising plants to the existing science curriculum was a more time-consuming process to both of us because Jinju had predetermined step by step science teaching units to be completed, and most of the science content was science experiment. Thus, we needed careful attention to match the contents of our STS reflective activity to the ones of the existing science curriculum in terms of content, scope, and teaching method (experiment). In our fourth meeting (Researcher's Journal, 8/26/2003), Jinju suggested that we could use two lessons of 'Acidity and Alkalinity' Unit in the science curriculum: 'Acid Rain' and 'Acid Fluid and Alkaline Fluid.' After a week of intensive investigation, we decided to plant two garlic gloves in each of the four different soils: 1) regular soil with organically decomposed soil, 2) regular soil with artificial fertilizer, 3) regular soil, and 4) regular soil with strong acidity (four spoons of vinegar per week). I also talked to Dr. Min to get better ideas of how to do a more useful scientific experiment with planting garlic: how to control variables, how to make a useful checklist, and how to compare the results. In terms of selecting garlic samples, for example, we collected some soil in my maternal grandmother's farm, stirred well, and then divided it into four. We also collected garlic harvested at the same farm of my maternal grandmother's. I carefully examined the size, colour, and gloss of garlic. Then, I selected 16 gloves of garlic which are almost the same size.

Planting garlic was taught on September, 30. It was always amazing to see Jinju's introduction to each reflective activity. The actual lessons were divided into two periods: designing scientific experiment and planting garlic. At the beginning of the first period, Jinju showed a simple experiment on the characteristics of alkaline and acid fluids with litmus paper. After the experiment, she asked, "Why did vinegar change the blue litmus paper into red?"

> *Suman (M):* Vinegar is acid fluid.
>
> *Teacher:* What does acidity remind you of?
>
> *Class:* Acid rain. [Children know this because acid rain is a big STS issue in Korea.]
>
> *Teacher:* Where do you think does acid rain come?
>
> *Hana (M):* It comes from exhaust gas from cars and factories.
>
> *Teacher:* Anyone else?
>
> *Jaemin (M):* Yes, that's because that thing [exhaust gas] goes into the air and comes down again. (Class Recording, 9/30/2003)

After that, Jinju explained how sulphur and nitrogen oxides are released from the fossil fuel into the atmosphere. She, then, explained how acid precipitation affects soil, rocks, water, vegetation, animals, and humans by showing the pictures of dead trees, polluted streams, erosive marble statues, loss of hair, and skin diseases. She also emphasized that the excessive use of fossil fuels and agricultural chemicals are the main sources of environmental problems in Korea. However, she had to search information for over two hours to deliver the simple piece of this explanation.

At this point, she asked a question, "What results will we get, if we continue to use fossil fuels and agricultural chemicals excessively?" and she led a discussion as below:

> *Jaemin (M):* Now, we couldn't walk without an umbrella.
>
> *Teacher:* Other reflections?
>
> *Chulsu (M):* If people continue to eat polluted food, we will be damaged.
>
> *Teacher:* That's right. Then, what about our beautiful nature? What about plants?
>
> *Gangmin (M):* If nature is polluted by acid rain, we cannot go outside and play with fun. (Class Recording, 9/30/2003)

As the next step, Jinju grabbed a piece of garlic and said, "Do you know how much garlic you eat a day?" Children seemed quite puzzled with the question. Then, she continued to explain about garlic: how they grow and how they help us to grow healthily. She continued to challenge the children by asking, "Do you know how we grow garlic?" Children seemed stunned this time by her question, and no one could answer her question at all. That was probably because they have not thought about it even if they always could see garlic at home. Breaking a moment of silence, Jinju said, "I will tell you the secret. You can simply put a glove of garlic in soil. And that's it." Some children responded by saying, "Is it right?" As a next step, Jinju discussed all aspects of the scientific experiment with children for about 30 minutes: purpose, conditions and variables to be controlled, procedure, observation checklist, and possible results. Jinju especially spent much time in discussing how to control garlic, soil, pebble, watering, sunshine, and the procedure children must follow when they plant garlic.

Children were finally out in a school farm in the second period, and they were so excited. I was happy too because I heard some of the children constantly asking going out to the school farm and planting garlic rather than learning hard scientific methodology in the first class. They were all equipped with what they needed to plant garlic: artificial fertilizer, 8 flowerpots, transparent vinyl gloves, dozens of garden trowels, pebbles, and recycled newspapers. Children started to plant garlic, and we had to help all the children who constantly had difficulty in planting garlic. The most frequent questions children asked to us were, "How can we add artificial fertilizer?" "How can we plant garlic?" "How deep do we need to put this garlic?" (Field Notes, 9/30/2003) Jinju seemed puzzled with these questions, and, accordingly, she frequently had to ask me to help in both answering children's questions and planting garlic for the children. When all the garlic was planted, we put all the 8 flowerpots in front of the building where they could get equal sunshine.

It was a few weeks later that Jinju called me and reported that the first garlic finally came out. However, as time went on, we found the garlic in regular soil and in the soil with artificial fertilizer were growing better than the one in organically decomposed soil. Children watered their pots regularly and recorded the growth of their garlic on their observation checklists. However, Jinju could not help but become concerned about the growth of garlic because some children often told Jinju, "The garlic in regular soil is growing best." (Field Note, 10/23) In reality, it caused us a lot of concern, and it became our first job to go to the flowerpots, to see how they grew, and to make a wish that garlic in decomposed soil would grow best. Maybe, owing to our true wish, as we moved into November, the growth of the garlic sprouts in decomposed soil finally surpassed the ones of the others.

The final results were almost the same with our original prediction. The garlic in decomposed soil and artificial fertilizer grew best and the garlic in strong acidity did grow for a while, but they all died out after about a month later. At this point, Jinju met another difficulty in explaining the results of the scientific experiment with garlic, particularly because the growth of the garlic in decomposed soil and artificial fertilizer looked almost the same in terms of height, width, color, and root. We again asked help from Dr. Min for our better explanations, and we learned some good insights from him. For example, Dr. Min confirmed the fact that the garlic in decomposed soil had many tiny root hairs that proved that the soil is rich with natural nutrients, and the tiny root hairs enable the garlic in the soil to absorb more nutrients through chemical reactions. Dr. Min taught us helpful scientific knowledge on how the chemical reactions happen theoretically, why organic food is healthy and, subsequently, why agricultural chemicals must be used cautiously without harming humans and nature seriously. With his help, Jinju was able to provide children with a more meaningful explanation too. For example, by explaining the combined roles of precipitation, air, soil, decomposing organisms, and climate for raising garlic ecologically, Jinju could teach how and why nature and all the organisms in it are important to the growth of garlic and to human beings. Thus, as non-experts in science, we had a difficulty with the lack of scientific knowledge in this activity such as curriculum planning, implementation, and evaluation. I believe, with the help of Dr. Min, this activity became more successful in growing children's mind of loving nature based on scientific literacy.

Fusion of Scientific Literacy and Mind of Loving Nature

There was an interesting happening with this reflective activity. It was a lunch time break on November, 12 that Taijo came to Jinju and cried. Other children explained to Jinju that Taijo fought with a child from one of the other classes because the child stepped on one of our garlic pots, one of the two with regular soil, and, thus, two garlic sprouts in the pot were crushed. When Jinju asked an explanation from Taijo, he said:

> *Taijo:* When I was watering the garlic sprouts, that child ran over the garlic pots and stepped on one of our garlic pots.
>
> *Jinju:* So…
>
> *Taijo:* I shouted 'Hey you. You crushed our garlic sprouts.' But he didn't say he was sorry for what he had done. So, I got mad and fought with him. (Reconstructed Quote in Researcher's Journal, 11/17/2003)

The child who crushed our garlic pot seemed to be in a hurry to play soccer in the playground. The class became so mad about this incident. Jinju and many of her students went to the place where the garlic pots were located and found two garlic sprouts that seemed too damaged to survive. Jinju became so hopeless with the crushed garlic sprouts all day long. Next day she finally called me and explained what had happened to the garlic sprouts in detail. She said she was not sure what she should do with those crushed garlic sprouts. She also said she was in the dilemma of burying them in a school farm in front of her class or simply throwing them away when her children were absent because her throwing them away might not be a right alternative of educating children to respect and care for nature. After listening to her struggle, I could not help but laugh because of Jinju's genuine concern for her children. Another interesting thing was that Jinju did not know that garlic sprouts would grow again from the same garlic glove. As soon as I hung up the phone, I went to the school and cut the damaged part of the sprout and replanted it in another flowerpot. Jinju was a little ashamed but so excited with my help. She said she was happy to tell her class what had happened to his the garlic pot. From the moment, the damaged garlic sprout had been taken special care by all the children in the class.

On the last day of my presence in Jinju's class (12/30/2003) children brought all their garlic pots to the classroom. Jinju, first, explained that all the garlic would be sacrificed for this experiment, and she took out garlic from the four different soils. All the children compared the final results, wrote their final reflection, and had a reflective discussion about the results they got. Taijo wrote his reflection as follows:

> By planting garlic, I came to know the process of plants' growth like garlic before they become edible for us. It was a real wonder to see the growing process of garlic because there is a great difference between the quality of soil and the growth of garlic. I've always wondered which one would grow better between organically decomposed soil and soil with artificial fertilizer and it was good to see the result. I've come to know that plants can hardly grow in acidic soil too. So, I think that people should not pollute our environment because people will be damaged if they continue to destruct our environment. Through this activity, I've come to know how much nature means to us. So, from now on, I will try my best to love our nature and all the living creatures. (Children's Work, 12/30/2003)

I saw Taijo wondering about how to grow garlic when Jinju held a piece of garlic, excited when he planted garlic, being happy with watering their garlic sprouts, being mad at his friend who crushed our garlic pots, exited again with the rebirth of garlic, and becoming happy with unravelling his scientific wonders about the growth of garlic before it becomes edible for him. I saw how much those garlic sprouts meant to the children and Jinju when they got upset with the unfortunate happening with the crushed garlic pot, and when Jinju desperately called me and expressed her feeling of trouble with the crushed garlic pot.

I saw that scientific literacy takes on more meaning in the praxis of Taijo's mind of loving nature and his scientific literacy as reflection does in the praxis of reflection and action.

When I took Noddings' lecture at WestCAST conference at my university (Researcher's Journal, 2/17/2003), Noddings strongly emphasized that loving and caring for nature is an essential value in the age of globalization because nature cares for us. I came to know that cramming the importance of preserving our nature through facts and theories alone would not make any big difference in Taijo's practices of loving nature. I also came to know that Taijo's scientific unravelling of how and why garlic should grow well for our health added a deeper understanding for his loving and caring nature. I came to know that children's practices of loving nature would be more feasible when nature finds a place of meaning in children's lives by children's own conscious interactions with nature. Indeed, our reflective space of raising garlic provided Taijo with a meaningful space of growing his caring spirit for nature through his reflections on people, nature, and his scientific wonders.

However, we know that some of the children couldn't find themselves quite happy in growing garlic because they were in charge of raising garlic in the soil with strong acidity. They saw little sprouts coming out at the beginning, but they had to see all the sprouts soon died. However, they watered their own garlic pots for more than two months to continue the scientific experiment. Upon my reflection, I feel I am sorry that I did not pay attention to their feelings. How meaningless experience would it be to water the garlic pot without any noticing of a single sprout. It would have been more desirable, if either Jinju or I had been solely responsible for raising those garlic pots with strong acidity.

Struggle with Uncertainty (10/1-11/6/2003)

Jinju and I had a great difficulty with uncertainty during this period mainly because of my lack of consciousness on the negotiation process at the beginning. To me, the difficulty was my struggle in finding a space in Jinju's classroom. As far as the reflective lessons were concerned, she was contributing a lot to this study. But I needed more than that because the purposes of this study could not be merely accomplished by delivering good lessons. I wanted to know more about the classroom culture: people, contexts, and interactions. But I could not dare to continue to ask her to allow me in her classroom because she showed her uncomfortable feelings whenever I tried to persuade her. There was also no designated space for me to stay and read children's work in school. I had to ask other teachers whether I could stay in their special rooms such as science room and school library. Sometimes, I had to work in the middle of the aisles in school. Besides, Jinju did not seem to pay much attention to the reflective environments such as STS readings and writing her feedback in children's STS journals in her busy life with other work she had to do.

On the other hand, Jinju was struggling with discontinuity she faced with my presence. She was quite burdened with showing her class to a stranger. She said:

> At first, I worried what I should do for you… I focused on what you would want from me and it made me worry while I was teaching. It was the same feeling when I opened my class to other colleagues or superintendents… Whether one person comes or ten persons come, teachers worry with same stress. I did not know that you should be involved in my class that much. (Final Interview, 12/30/2003)

I did not continue to persuade her to open her space for me because my active request might both harm my effort to build trust with her and, thus, could cause additional uncomfortable feeling to Jinju. However, I believed that she would open her space sometime and, thus, tried to gain my space step by step based on the improvement of our relationship. There was another reason that this period of struggle lasted so long partly because Jinju was busy preparing for art festival in which she was in charge of her play staged and partly because children had a mid term academic achievement test from which Jinju had to have at least average grade mark compared with other classes. I had to recede from my active participation in the class for a while because it was morally not desirable to harm Jinju's other aspects of life as a teacher. As a result, we completed only two reflective activities during October.

Interview with Parents: How Technology Has Changed Our Society (10/16)

The purpose of this historical inquiry was to provide children with a reflective space in which they come to understand how technology has changed their lives by interviewing their parents. Noori (1995) contended that by listening to the voices of others, we have a greater understanding of moral issues. The Korean economy has grown so dramatically that this study is a useful way of gaining moral insights on their everyday STS issues by comparing what the children have gained and lost with the development of science and technology. This activity was originally useful in the pilot study and reused in this study again. We used the unit of 'Our Shining Economic Development' in the existing social studies curriculum.

First, all children were asked to choose a topic on their own or from the lists we had given as exemplary topics below:

> Heating, house, washing clothes, transportation, kitchen, cooking, school life, play, food, mail, shopping, occupation, neighbourhood, water, air, environment, hair style, bathing, stationery, advertisement, phone, remote controller, hospital, pet, tour, after school life, school subjects, lunch time, banking, exercise, leisure, snack, washing hair, school lunch, food storage, toys, homework, toilet

As Moon (1999) pointed out, educators should pay attention to children's individual difference, age, and conducive environment to foster learning through reflection. Our guidance of providing the above lists was, thus, part of our efforts to help each child to find their most suitable topics based on their personality, ability, interest, and social setting with a purpose of making elementary children's reflection more feasible and meaningful to them.

Secondly, all children were asked to do an interview with one of their parents. Listening to others' stories is very important because it helps them to go through others' experiences of seeing technologies, which can ultimately lead them to learn more fruitful moral insights and sensitivity (Meyer, 1994). By doing this interview, each child inquired into their parents' elementary school life through the lens of technology, compared parents' past life with less developed technology with their own lives with better developed technology, and recreated their own meanings of technology in their lives. After this activity, children were expected to know how science and technology would affect their lives and how to use the technologies in their surroundings for the self, others, and nature in more meaningful ways.

Third, children drew the comparative drawing of the past life and the present life, wrote reflections, did a small and whole group discussion, presented their work to the class, and mounted their reflective post-its on others' work.

Social Issues in Plaything

The following is Eunhee's reflection on her inquiry on 'how technologies have changed the ways people play':

> I sometimes felt things were unfair to women. The reason was that men usually had many things to play but women had to care for house chores in the past. And I've come to know that people in the past used to play in nature. So, I think there are rather some negative aspects of development [of science and technology]. We don't play

> with friends as people used to do. We tend to have bad eye sights too. So, I thought that playthings in the past are better than the ones we have now. And as we have more things to do alone today, we will have more and more things to do alone in the future. I hope I had more old playthings because I have found fun in playing old playthings so far. (Children's Work, 10/16/2003)

Eunhee interviewed both of her parents, and she gave us a few important insights. First, Eunhee's inquiry was also three-dimensional as our inquiry was in this study. She not only actively positioned parents (or herself) in their (or her) personal-social contexts but also actively positioned them (or herself) in a continuum of the imagined past, the imagined now, and the imagined future in a place of her interview with her parents. I believe that her active positioning in three-dimensional space came from her desire for learning based on her own interest and social setting. Second, by positioning people in three-dimensional space, Eunhee was able to address people's moral lives in relation to the existential conditions of technology people interact with. At the beginning, she addressed people's lives with their playthings in the past with a feminist voice, and, later, she addressed people's lives with their playthings at the present with another critical voice by criticizing the negative influences of today's technological society: bad eye sight and individualized life style. By comparing the imagined past and the imagined present, she gained insights on what people at the present have gained or lost such as women's rights, bad eye sight, and individualized life style with the development of science and technology. By doing this comparison, she gained an understanding that playthings in the past were better than the ones she has at the present. Then, she addressed people's lives in the imagined future, and she said that people would do things alone in the future more than they do at the present with the development of science and technology. Her positioning in the future again led her to her imagined present and enabled her to know what existential conditions of technology should be transformed to lead a good life with playthings by saying, “I hope I had more old playthings.” Eunhee’s reflection is, indeed, her narrative experience of knowing her moral selves and her existential conditions of science and technology.

Eunhee presented her reflection in front of the class, and, soon, Jinju led a long discussion by positioning children in the imagined past contexts as follows:

> *Teacher:* How did your parents think about their childhoods?
>
> *Eunhee (F):* They said they were missing their young ages.
>
> *Hyunho (M):* My father did too.
>
> *Teacher:* (Looking at the whole class) what else did you find about playthings?
>
> *Miok (F):* Can I show mine too?
>
> *Teacher:* Yes, go ahead.
>
> *Miok (F):* This picture shows a child who is only playing with a computer at home and becoming skinny. [Skinny means unhealthy or weak in this context.] I hope children would play more with their family like the children in the past.
>
> *Teacher:* Other reflections?
>
> *Geunho (M):* I hope I could play outside so hard like in the past and I don’t want to play inside at home. That’s because if we play inside at home, it doesn’t do us good. Our body also doesn’t go along with natural life [nature] and our body will become skinnier [unhealthier]…
>
> *Teacher:* Did you listen to Geunho’s reflection well? What playthings did you see in Geunho’s picture?
>
> *Class:* Playing tip cat, Cockfighting, cow riding [no real cow riding], horse riding [no real horse riding], soccer, hide and seek, sledding, playing marbles, swimming [in the stream]. (Class Recording, 10/6/2003)

In the above discussion, Jinju asked Eunhee how her parents think about their young ages, and this question initiated other children to address their thoughts and feelings actively and freely. It is interesting that, after her first question, she was able to lead a good whole group reflection by using 'what' type questions only because children had already enough knowledge to participate in the discussion actively and freely. After having the children learn from their parents' lives with playthings in the past, Jinju repositioned children with their added learning experiences in the imagined present contexts. The discussion continued as follows:

> *Teacher:* What benefit can we get, if we play outside?
>
> *Minseok (M):* It will be good for our health.
>
> *Dolshei (M):* We make friends with nature.
>
> *Nari (F):* We can go along with friends.
>
> *Mina (F):* We will make our friendships tighter.
>
> *Teacher:* Then, how about today's plaything?
>
> *Sora (F):* There are not many good things.
>
> *Jaemin (M):* If we only do computer games, our eyes will be worse and our bodies will be worse too. [Jaemin usually plays with his computer more than an average of 5 hours per day during weekdays.]
>
> *Jaisun (M):* Besides, people's personalities become dirty. [Jaisun usually plays with his computer more than an average of 4 hours per day during weekdays.]
>
> *Byungsu (M):* Yes, people say bad languages and bull shit. [Byungsu usually plays with his computer more than an average of 4 hours per day during weekdays.]
>
> *Jaemin (M):* I learned so many bad languages [from using computer].
>
> *Male Children:* Huck Huck… Poke Poke… [Sex slang]

Teacher: (Overlooking children's sex slang), what else did you feel?

Minseok (M): Obesity problems.

Teacher: Why?

Minseok (M): That's because people don't exercise. (Class Recording, 10/6/2003)

As shown at the first part, as soon as Jinju initiated a question, "What benefit can we get, if we play outside?" children actively began imagining their good present lives with the existential conditions of the past. Their active imagining seems natural because the children in this community can barely have any chance to free their foot off the concretized world except for the school playground. Later, children addressed eye problems, personality problems, and bad language practices in relation to the negative influences of computers. It is clear that children made sense of how technology affects their lives by comparing their lives with their parents' lives in terms of technological development. The dialogue continued in such a way that Jinju tried to position children's learning from the past in a more positive and neutral dimension:

> *Teacher:* Class. Concentration! [This is the way Jinju usually get children's attention.] If you know this, you will be a great person. Here, playthings have been changed, aren't they? Here, what technologies do you think have been developed?
>
> *Chulsu (M):* Computer and electric communication technologies have changed.
>
> *Teacher:* With the development of computer technology, what kinds of other technologies have been developed?
>
> *Sangsu (M):* We can do things at home instead of doing those outside.
>
> *Teacher:* What are those?
>
> *Class:* Game, shopping, mail, email, chatting.

Taijo (M): Instead of going to the station to reserve train tickets, we can do it by Internet.

Teacher: What else?

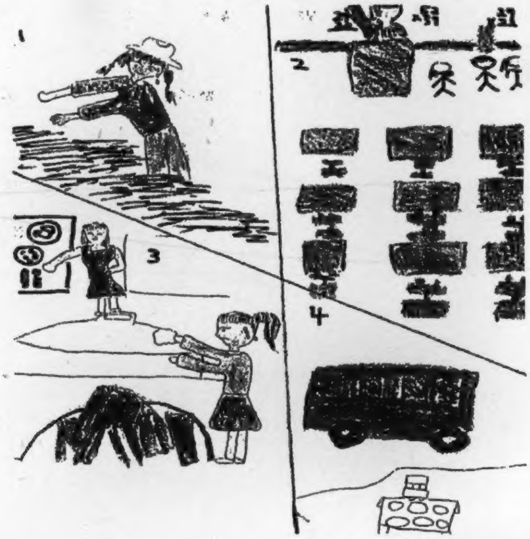
Dalai (F): Instead of going to movie theatres, we can see movies with a computer.

Teacher: Then, how would you feel if you were in the past without those technologies? (Class Recording, 10/6/2003)

Social Issues in After School Life

After a while of continued discussion, Jinju moved to another topic, 'After School Life.' Sora drew a picture of the children's lives in the past and at the present as follows:

Figure 7. Sora's drawing on 'how technology has changed children's after school life



Sora wrote her reflection as follows:

> No. 1 is a picture of a student who does farming after school. No. 2 is a picture of students taking lessons in a private institute. No. 3 is a picture of students cooking and setting a table for their family. [The girl at the bottom is firing wood to cook rice.] No. 4 is a picture of a student having a dinner after returning from a private institute. [She drew a private institute bus and a dinner table only.]

> I summarized my knowing and thought after investigating this as follows. I've easily come to feel that our country has been developed so much. And there weren't many things to do in old times, but today we can do a computer and go to places such as play land and funny places. And children used to do things on their own after their only study at school [in old times]. But there are more students who learn at private institutes [today]. It seems that there is a great difference between the old times and today. (Children's Work, 10/6/2003)

Elementary school girls in old times are helping both farming and house chores in the pictures above. Unlike Eunhee, Sora does not raise a critical voice in her reflection. However, it is apparent that Sora sees that, if she were in her parents' times with less developed technology, she would not find much meaning as she does with better developed technology today. She recognizes today's technology as a useful means by which she lives her life more meaningfully. I spent much time with Sora throughout the study, and she constantly recognized her technologies as helpful sources for her growth. Jinju and her class led a discussion about children's after school life as follows:

> *Teacher:* Well, Class. In Sora's picture, children are busy with their learning at private institutes after school instead of working in a farm or setting a table for their family. Now, we have many private institutes. How do the changes affect your life in positive or negative ways?
>
> *Somi (F):* A good thing is that we can learn at private institutes and become great persons in the future. A bad thing is that we become so tired with going to one private institute to another without having a moment of helping my mother.
>
> *Teacher:* Become so tired and learn more… Anything else?
>
> *Dolshei (M):* Children learn things in advance [in private institutes]. So, they don't participate in school lessons very well because they couldn't find them interesting.
>
> *Class:* That's right.
>
> *Taijo (M):* I will complement what Dolshei said. A good thing is that we can get good test scores by learning at private institutes. A bad thing is that we get stress because going to private institutes stop us from playing with friends.

Class: That's right. (A big applause)

Teacher: Do you all agree on that?

Class: Yes. (A big applause again)

Teacher: What kinds of technologies do you see here? (Class Recording, 10/6/2003)

During this time, children strongly expressed their stress and lack of playtime because of going to private institutes. The struggle of going to private institutes was a major stress to many of the children in Jinju's class, particularly, to Somi. Somi was going to two private institutes (Math, and English) and had three private lessons at home (Math, Chinese, piano) during this study. At the final interview, I asked to Somi, "What is your comprehensive feeling about learning private lessons at the private institutes and at home?" Somi said,

> I feel like my life is been dragged by those private institutes. I don't want to learn private lessons anymore… I particularly hate to learn piano lesson because I have to practice a lot to take one lesson. (12/27/2003)

Somi's mother worked in shifts at a nearby factory from 5 p. m. to 3 a. m. for three or four days per week. I presume that Somi's mother had to spend almost all her wages for Somi's private education. I imagine that Somi's mother did not wish her daughter to inherit her difficult life as a woman worker when she is grown up, and Somi's mother found education the only route of helping Somi's better life.

But the struggle of going to private institutes was another world's story to Dalai. There were only three children who weren't going to any private institute at the time I was in the Jinju's classroom: Dolshei, Mina, and Dalai. However, Dalai was the only child who could afford to learn at private institutes among the three children. Dalai did an interview on her parents' after school life, and she wrote her reflection as follows:

> I don't know how things are in private institutes. But I always see children going to private institutes directly after school. I feel sorry for those children, and I feel I am the person of freedom. (Children's Work, 10/6/2003)

Dalai presented her work in front of the class, and the whole class went into a big fuss. Dalai said that her parents did not send her to any private institutes because they were feeling really sorry for the children who were always busy with all kinds of extra learning after school both at private institutes and at home. When Jinju asked what Dalai was doing at home instead of going to private institutes, Dalai said that her parents, instead, provided Dalai with a variety of opportunities she could find fun such as swimming, playing tennis, and reading discussion class (Class Recording, 10/6/2003).

It is interesting that the technology of private institute in Sora's, Somi's, and Dalai's lives has different meanings. The technology of private institute provided Sora's life with joy and liveliness because all of her family members were not available at home to care for her after school life (Interview, 12/20/2003). On the contrary, Somi found herself always struggling with it even if Somi's learning capacity and economic condition are not worse than Sora's (Interview, 12/27/2003). The secret is narrated later in Sora's story in STS Practice Journal in this chapter. To Dalai, their parents were all well educated, and her mother was a sole housewife. Her parents' sincere caring provided Dalai with a nice environment in which she became a successful manager of her life. In this way, Dalai neither had to find much life meaning through the technology of private institute nor had to struggle with it (Interview, 12/27/2003).

Social Issues in Washing Machine

Taijo did a kind of women's studies. He worked on an interesting topic called 'Washing Clothes.' Taijo said, "In old times, women went to a nearby washing place beside a stream where they used a flat stone to wash clothes." (Class Recording, 10/6/2003) Taijo further explained the procedure of how women washed clothes in old times.

1. Women hit clothes with a laundry paddle and wash them in a steam by hand.
2. Women whiten their clothes by using hand-made bleaching power made from burning plants.
3. Women wash clothes cleanly and dry them on a sunny place.
4. Women starch clothes and fold them one by one neatly.
5. Women hit the clothes again with a paddle to flatten wrinkles and to make sharp seams.
6. Women smooth and straighten clothes by ironing. [A Korean traditional iron was heated on a fire pot.]

Taijo explained that washing time in old times provided women with a free chat time by which they enjoyed listening to the news in their community. He also talked about today's laundry and it was interesting that he always used 'people' instead of using 'women' while talking about today's washing practices. It is more interesting that, in his picture, his mother is sitting on a sofa while he is doing a laundry for his mother. When his mother says, 'Taijo, would you do a laundry for me?' in his picture, he says, 'Yes, mom.' Taijo also proudly said that he was helping his mother oftentimes. Taijo expressed his feeling after interviewing his mother as follows:

> *Teacher:* What did you feel after interviewing your mother?
>
> *Taijo (M):* (He is reading his reflection on the back of his picture) It was miraculous to see all the changes with washing clothes from old times to today. For example, in old times, women had a great difficulty in washing clothes. But we live in a world in which we finish all the washing jobs with a single washing machine. I hope that science and technology will change many uncomfortable things and bring about many comfortable things in the future.
>
> *Teacher:* Good job! (After a pause) Class! Any reflections on Taijo's work?
>
> *Chulsu (M):* It should be so uncomfortable to the women in old times without a washing machine. It looks terrible to break ice to wash clothes in winter. We live a very comfortable life because we can take a hot shower in winter today. (Class Recording, 10/6/2003)

As shown in his reflection, Taijo also made sense of women's rights issues by comparing mothers' lives in the past and his mother's life today while Sora made sense of children's rights issues from hers. Whereas Jinju never noticed women's rights issues were emerging during the discussion, the class became naturally involved with a discussion of how technology has especially contributed to the better lives of women, and some male children such as when Chulsu expressed strong sympathy for the women's hard labour in old times.

Reflection and Social Issues in Children's Lives

This incident reminded me of Meyer's ideas on moral education. Meyer (1994) pointed out that the ability to empathize with others and imaginatively construct their unique view points is critical to moral insight and wise moral choice. By listening to her parents' stories, Eunhee empathized with their parents and imaginatively constructed her view of playthings. From this, she also made a good moral choice of playing more with traditional playthings. By listening to her mother's stories, Sora did go through a similar experience to Eunhee, and Sora's inquiry led her to see her present life with better technology in a more meaningful way. Taijo also did go through similar experiences to Eunhee's and Sora's, and his inquiry led him not only to respect the ways washing machines helped women to free themselves from their hard labour but also to value the role of future science and technology.

As shown above, all the above children were able to address many socio-historical issues behind the curtain of science and technology: women's rights issues, children's rights issues, stress, health issues, violence issues (bad language practices), and individualized life. Other children also addressed their STS issues based on the following topics:

Table 3

Topics of Children's Interviews with Their Parents

Topic	No.	Topic	No.	Topic	No.
Playthings	8	House	2	Community life	2
After school life	5	Cooking	2	School life	2
Washing clothes	4	Heating	2	Bathing	1
School lunch time	3	Swing	2	Washing hair	1

Note. No. stands for the number of children who worked on the corresponding topic.

We saw how a washing machine could bring new meanings to Taijo's life. We also saw how Eunhee and Sora could see meanings of technology differently out of their own judgment based on their personality, ability, interest, and social setting. Nevertheless, they were all the same in that they pursued their knowing by working with their own existential conditions of technology. This is probably the reason they became actively able to address STS issues in a more broadened temporal context by comparing things in the present and the past. Indeed, empathizing with their parents and constructing their unique views imaginatively led these children to moral insights and wise moral choices.

In Chapter 3, I addressed current challenges of STS education: narrow subject based curriculum (Yager, 1995), misconception of science and science education (Osborne 2000), science-technology based STS education, lack of distinct STS curriculum in social studies, and lack of meaningful claims of social studies educators in terms of the inclusion of STS education in the social studies curriculum. We often see STS educational research dealing with topics which are distant from children's experiential life such as ozone layer, global warming, and deforestation. If we look closely, however, there are plenty of STS topics embedded in children's lives, and I believe this place is where children can be able to build up their own moral capacity to know and transform their moral selves and their existential conditions of science and technology.

Video Clip on Cattle Dung Beetle (10/23)

The purpose of this activity was to provide children with a reflective space in which 1) children come to know how scientists should work on scientific research for people and nature and 2) children come to know how and why they should care for nature, particularly, animals. This activity came from an accidental happening. It was when I saw TV with my son that I found a scientific research documentary on cattle dung beetle produced by KBS (Korean Broadcasting Station) as part of environmental education. The summary of this documentary is as follows.

Cattle dung beetles once flourished at every corner in Korean peninsula. But this curious little insect is hardly found in Korea except Jeju Island the environment of which is specially guarded by the Korean government for tourism industry. The sole goal of cattle dung beetles is cattle dung. Cattle dung beetles have become endangered species in Korea even if the number of cattle today is several times more than the one in two decades ago. There are two main reasons for their disappearance. First, almost all cattle in Korea now are raised in barns the floors of which are made from concrete, and the cattle dung in a barn is collected by agricultural machinery, moved to a special place designated, and fermented as a natural fertilizer. Second, cattle dung beetles can hardly survive the toxic ingredients in the cattle dung contaminated with excessive pesticide chemicals sprayed by the farmers.

Reflection and Somi's Ontological Growth

At the beginning of this activity, Jinju wrote two questions and asked children to write their reflections after watching the video clip. The two questions were, "Why do scientists pay attention to cattle dung beetles?" and "What good aspects did the scientists find from cattle dung beetles?" As soon as the video tape was turned on, Somi saw a group of scientists desperately looking for cattle dung beetles all around Korean Peninsula but their tries were all in vain. The scientists, then, moved to Jeju Island and found cattle dung beetles on the grassland where cattle were grazing. From this moment, Somi had to see frequent sickening sights of cattle dung beetles working with cattle dung as other children had to do too. She covered up her eyes not to see the dirty cattle dung. But after a while of discomfort, she started to become interested in learning about the small animal. She saw the narrator of this scientific research documentary explaining all about cattle dung beetles: biological characteristics, habitat, courtship, and their life cycle. One explanation of the narrator was not shifted to another without explaining another meaning of cattle dung to cattle dung beetles. Somi watched a couple of scientific experiments discussing the importance of cattle dung beetles. Somi seemed quite amazed with what cattle dung, which seemed useless to her, meant to this small animal. Somi stayed silent when she heard the narrator telling that cattle dung beetles were the victim of environmental destruction and why these small animals must thrive in our land. After she saw the final zoomed scene of a big cattle dung beetle standing firm on a piece of cattle dung in a twinkling red sunset background, Somi could not help but give a big applause to the 'giant' cattle dung beetle.

After watching the video clip, Jinju asked the class, "Why do the scientists pay attention to cattle dung beetles?" The following is the discussion among the class:

> *Teacher:* Yes, they decompose cattle dung. What are the other good aspects?
>
> *Dalai (F):* Once cattle dung is decomposed, we can process cattle dung without any harm. As a next step, that [decomposed] cattle dung goes into the soil and becomes good natural fertilizer by which grass grows so well.
>
> *Teacher:* What else?
>
> *Byungsu (M):* As we saw in the video, scientists planted tomatoes in many different soils, and the tomato in the soil with decomposed cattle dung grew the best. So, I've come to know the importance of cattle dung beetles.
>
> *Class:* Applause. [They applaud the cattle dung beetles.]
>
> *Teacher:* Anyway, what was the reason the plants in the soil decomposed by cattle dung grew well?
>
> *Class:* Micro organism.
>
> *Teacher:* Why do they live there?
>
> *Dalai (F):* That's because cattle dung beetles decomposed cattle dung well.
>
> *Teacher:* Then, what good aspects did scientists find from cattle dung beetles? Who will complement?
>
> *Chosun (F):* Micro organisms thrive where cattle dung beetles live and they decompose cattle dung completely. And there aren't many flies because cattle dung beetles carry ticks which feed on fly eggs.

> *Teacher:* That's right. Cattle dung beetles make holes in cattle dung and provide oxygen so that a variety of micro organisms live well. And these micro organisms decompose cattle dung into natural fertilizer. And plants grow with it.
>
> *Somi (F):* Wow, cattle dung beetles do so many good things! (10/16/2003)

After the whole group reflection, Somi had to write reflections on the two questions Jinju gave at the beginning of the lesson. To the second question, "What good aspects did the scientists find from cattle dung beetles?" Somi wrote:

> Flies swarm into where cattle dung is, but a cattle dung beetle carries ticks on its body to drive flies away. As long as it carries [ticks], everything is all right because ticks feed on flies' eggs. And there are baby cattle dung beetles too. Besides, males have horns but females don't have horns. When males follow females, we call it 'courtship.' This behaviour means their expression of affection. When the scientists [in the documentary] did research, they prepared for both the cattle dung gathered from a pasture of agricultural chemicals and the cattle dung gathered from natural environment. They put 50 cattle dung beetles into each container. They also found that the cattle dung in natural environment was completely decomposed. But the cattle dung with agricultural chemicals was hardly decomposed, and 3 cattle dung beetles were found dead in the container. This is why cattle dung beetles die, when they eat cattle dung holding agricultural chemicals. Now cattle do not live in nature [By this, she means cattle are not raised in natural environment.] and, thus, cattle dung has faded away. So, cattle dung beetles also have faded away. (Children's Work, 10/23/2003)

It was interesting that Somi, first, drew two cattle dung beetles while other children only wrote their reflections. She also wrote three impressive sentences in a rectangular that she copied from the narrator in the video clip:

> Cattle dung is not simple excrement.
> Cattle dung is the world of cattle dung beetles.
> Cattle dung beetles must live forever. (Children's Work, 10/23/2003)

Somi is a talented child in caring. Seeing her life almost always reminded me of seeing another Nightingale. That is why Jinju and I called her 'Nightingale Junior.' When I was in the field for four months, Somi did many kinds of class chores voluntarily such as cleaning classroom, throwing garbage, changing water in the class aquarium, feeding golden fish, and arranging children's meal plates after lunch. During our regular meeting (10/23/2003), Jinju said, "Whenever some bad incidents happen among friends, Somi goes to the child who was hurt from others and cares for the child. To Somi, It doesn't matter who they are." Jinju said Somi sometimes wrote letters for the children who were hurt from the quarrels among friends too. I enjoyed seeing the beauty of Somi in all of her writings, languages, body movements, and drawings while she was working with STS reflective activities.

Somi's beauty of caring is threaded into her future dream too. Somi's future dream was originally becoming a nurse and, next, becoming a doctor. However, after watching this little piece of video clip, she changed her dream to becoming a veterinarian. During the final interview with Somi (12/27/2003), I asked a few questions about her caring personality. She said she loved all kinds of animals, but she had never had an opportunity of raising a pet at home because of her father's objection. She said her father would not buy her a pet out of his concern that his daughter would spend most of her time in playing with the pet and would not study. The following is the dialogue between Somi and me about her caring personality:

> *Researcher:* Where do you think you originally had a mind of caring?
>
> *Somi:* When I go somewhere with my friends, they sometimes crush ants into death just for fun. When they continue to do so, I constantly ask them to stop… While I see them doing so… I feel sorry for the dead animals of all kinds…
>
> *Researcher:* When did you have your dream to become a veterinarian?
>
> *Somi:* In the middle of this semester.
>
> *Researcher:* Tell me more about it.

> *Somi:* At the beginning, I wanted to become a nurse, and, then, I wanted to become a doctor. And after seeing the video clip of cattle dung beetle, I started to think about becoming a veterinarian.
>
> *Researcher:* Why?
>
> *Somi:* I felt so sorry for cattle dung beetles. They always did and do us good, but they had to die because people used too much agricultural chemicals. They have no reason to die… And at that time, all the 12 fish at home died too.
>
> *Researcher:* Why did they all die?
>
> *Somi:* Those fish should have lived in warm water, but they died because I raised them in cold water. I was so sorry for them. And from the moment, I changed my dream.
>
> *Researcher:* You said your first dream was to become a nurse. Why did you wish to become a nurse?
>
> *Somi:* I once went to see a doctor because I had rash all over my body. And a nurse really cared for me so kindly.
>
> *Researcher:* How kindly did she treat you?
>
> *Somi:* At that time, I had something [a medical instrument like ear pads] on each side of my ears. When they became so hot, the nurse came to me and said, 'Do you feel all right? Do you feel hot? Do you want me to change them?'
>
> *Researcher:* Why did you wish to become a doctor then?
>
> *Somi:* I felt so sorry when I saw people who had mental diseases [on TV] at home. So, I wished to become a mental doctor. (Interview, 12/27/2003)

Children have different talents of their own. Somi is special because of her caring nature. However, many of the other talents except intelligence are not easily recognized as an important ability in schools in Korea. Kim, Kwon, & Kang (2003, p. 16) criticized the educational practices of rote learning in Korea by pointing out, "teacher-centered rote learning breaks up the interrelationships of morality, aesthetics, and life, and it ultimately dries up the liveliness of our life." As we see human history, we recognize how much our world owes to many heroines and heroes of caring spirit such as Nightingale, Mother Teresa, and Schweitzer without mentioning our mothers. In this world, however, we see so many immoral phenomena happening within the legitimate boundary, and many people live alienating lives and die from them. An example is the exploitation of others to gain profits. For example, in Korea, credit card companies have issued too many credit cards to win in the competitive market over other credit companies. As a result, Korea has now over 3 million credit delinquents. We often see some credit delinquents rob banks, commit suicide, and live in miserable conditions. Some of them even kill their wives, sons, and daughters because of their wrong moral conception that the rest of their family members should not suffer from the card debt difficulties they left. Kim (2000, p. 15) pointed out that, "people should make a shift from the use of reason to subjugate others to their egoistic system of logic… to the use of reason to dialogue with others." His insight tells us that reason becomes human beings' full moral capacity when it is used as the means to respect, care for, and dialogue with others, not as the means to inflict or exploit others.

The use of emotion, aesthetics, and will should be based on our humanity too. Somi's emotional, aesthetic, and rational experiences were made based on her humanistic values by feeling that cattle dung beetles have no reason to die. Her experiences empowered her to build a good will of respecting and caring for ill animals and, ultimately, led her to live a new storied life with the hope of becoming a veterinarian. As Connelly and Clandinin (1988) pointed out "to know something is to feel something, to value something, and to respond aesthetically," Somi's experiences grew in the same way. But I saw many male children in Jinju's class enjoying violent computer games in which they enjoy their aesthetic feelings of hitting and killing people, and several of them often mentioned that they were addicted to those games. From our experiences with Somi, Jinju and I shared a common idea that our education should work more on growing and strengthening children's moral capacities of emotion, aesthetics, and internal will based on humanistic values without mentioning reason. I believe that our moral life will becomes more beautiful and powerful when all these values become a real part of our life based on humanistic values.

Reflection and Children's Vision on Scientific Research

A few days after watching the video clip, Jinju and I had to face an aftermath of children's loving of cattle dung beetles. Several children wrote their reflections on this activity in their STS journals and, among them, Jinju found two interesting reflections. First, Jaemin wrote his hope for future scientific research as follows:

> ...Cattle dung beetles became a natural treasure. However, the problem is that even if there is cattle dung, cattle dung beetles cannot help but die because the cattle dung in a cattle barn is contaminated. I wish more scientists work on preserving endangered dung beetles and do their best to protect these animals. (STS journal, 10/27/2003)

Second, Dalai used an interesting newspaper clip titled as "What if cattle dung beetles perish?" This column is a book review of the Pulitzer Prize-winner Natalie Angier's book, *The Beauty of Beastly.* Dalai cut it from the newspaper and pasted it on her STS journal. Below is her reflection:

> A few days ago, I saw a video on cattle dung beetles. It was about a serious [environmental] problem in our country but this book reports a serious problem in other countries. If I have a time, I really want to read it. By using genetic engineering, I hope cattle dung beetles thrive on our land again. (STS Journal, 11/04/2003)

The video clip on cattle dung beetles was remembered as the second best meaningful activity among all the STS reflective activities when they were asked to choose their three most meaningful STS reflective activities in post-study questionnaire (See Appendix 6). Interestingly, three children among the fourteen children who chose this activity as one of their three most meaningful STS reflective activities related their meanings of learning to scientific research as follows:

> *Bomi (F):* Watching cattle dung beetles! That's because I feel proud of the scientists who try to find ways of preserving both our environment and living organisms.
>
> *Dongseo (M):* There are many different scientific researches, but I came to know that there are some researches for our environment.
>
> *Junsu (M):* People should think about our environment in developing [science and technology]. (Post-study questionnaire, 12/31/2003)

As you may notice, all the five children's meanings of learning from this activity are different from one another. It must be noted that in every reflective activity, we not only tried our best to be neutral in our value judgment but also did not summarize our teaching and children's reflections. By this, children could grow uniquely by growing and strengthening their own personalities, abilities, prior knowledge, and interests (See Appendix 7 for further understanding on how children's hopes for future science and technology have changed between pre-and post-study questionnaires).

In Korean classrooms, homeroom teachers oftentimes have their children watch many kinds of video clips on life organisms. However, having them just watch those is not enough to provide children with a space of reflection. After showing the video clip, Jinju initiated a whole group conversation, and, thus, provided a good reflective space of exchanging and expanding children's personal reflections they made during their watching. By active reflection, these children could create the unique meanings of nature in their lives.

Building a Shared Space of Meaning (11/7-12/30/2003)

There was one accidental happening which led Jinju to know more about who she is as a teacher. It was on October 13 that I was reading children's STS journals in the school library. Jinju came to me and seriously said:

> Teacher. I have something to ask you. That is… You know Byungsu. Byungsu was a very decent boy in the first semester, and he went along with his friends and me. But he continues to show such a terrible misbehaviour this semester… He doesn't listen to me at all and continues to fight with his children… I can hardly control his misbehaviour. So, would you counsel him because you are a man [like he is]? (Reconstructed quote in Researcher's Journal, 10/13/2003)

I asked Jinju to bring him to me. When Byungsu came in, I tried to comfort him first and said, "Byungsu. Why do you look so exhausted these days? Would you tell me about your concerns? I will help you as much as I can." Byungsu told his concerns as follows:

> *Byungsu:* It is too hard to live in school.
>
> *Researcher:* OK. Would you tell me your difficulties as concretely as possible?
>
> *Byungsu:* I get harsh reproach at home because I do not study very well, and I get reproach in school too. I feel exhausted all day long.
>
> *Researcher:* Why do you think you live in such a way?
>
> *Byungsu:* I am learning athletic training early morning from 7: 30 to 8: 30, but I really don't want to do it. [Some physically talented children take hard athletic training in school on a regular basis for an inter-school athletic competition in Korea.]
>
> *Researcher:* What do you want to do, then?
>
> *Byungsu:* I want to quit athletic training and study hard. I asked my P.E. teacher, but he did not allow it. I often came to school without eating breakfast. [His mother tries her best to wake him up, but she could hardly wake him up from fatigue.] and have to take hard physical training. When I am in lunch time I feel completely exhausted and cannot eat anything. (Reconstructed quote in Researcher's Journal, 10/13/2003)

He cried while talking to me, and I could not help but feel terrible because I saw all the chaps and cracks on his lips. After talking to him, I found that he was living terribly because there seemed no one who would really care for his internal and existential conditions. I went to Jinju, and Jinju also looked so concerned about Byungsu. She said she did her best to help him, but she said the results did not turn out well. We discussed how we could help him for a while and reached some ideas. First, Jinju called Byungsu's mother, and she discussed her concerns with Byungsu's mother. Second, Jinju asked the P.E. teacher to release Byungsu from his athletic training based on his mother's permission. Third, Jinju called Byungsu's mother again and asked special care from Byungsu's mother. Jinju also took special care of him for a while. After that, we were able to see him gaining his smile back until this study finished even if he did not study very hard as he said to me during our conversation.

There was another planned event through which Jinju came to know more about who I am as a researcher. I was invited to Jinju's graduate class by her professor and taught four hours of special lecture on data gathering and analysis in qualitative research. I intentionally spent one hour in explaining how to understand a child as a whole being. I explained it during a graduate class on October 22 as follows:

> A child has different abilities, personalities, prior knowledge, and the child has different environments to cope with. A child also has many different relationships to live with such as mother, father, friends, and teacher. So, a child's relationship with her or his teacher is just a part of the whole life meanings. That's why teachers have to understand a child's life as a whole entity first. Then, we are able to figure out what the child really needs to live a better life. The teacher's job is, then, to find one's best part to contribute to the growth of the child's whole life. We do qualitative research both to understand a child's whole life and to look for our best part for it. Contributing our best part to the growth of a child is our endeavour of teaching and the way of becoming a good teacher, and it is why qualitative research exists for us. (Reconstructed contents in Researcher's Journal, 3/17/2004)

Jinju neither talked about her feelings about my lecture nor expressed her feelings about Byungsu, but I was able to notice that she was in a serious turmoil after these two incidents.

It was on November 7 that I was reading children's reflections after they worked on 'Interview with Parents' at the outside corner of the school building where I was able to get nice sunshine. Suddenly, Jinju called me by cell phone, and asked where I was. She came to me and sat beside me. After a pause, she told me how she was going through her inner turmoil of struggling with defining who she is as a teacher:

> *Jinju:* So far, I think this study has not become mine. I thought that this study was yours, and I was only interested in how I could do to produce children's results based on your purposes. But I now feel that this study is not just yours but mine and children's too, and I want to do my best to build shared meanings with this study.
>
> *Researcher:* How come did you think that way?
>
> *Jinju:* So far, I have lived with a single interest in how I can teach things to teach effectively. But as you said, what meaning does it bring about to my life as a teacher? I mean teaching children based on my predetermined sets of goals… I really do think that I need to see every child as she or he really is. As I started to see this way, it seems that I also started to see and value the unique self of each child. It really does… Especially, Bin is doing so well in class. Bin raises her hands so many times. And Hana also does so well. Their presence was not noticed by me. But those two students have been by far the most noticeable children among all since we engaged in this study. Without your help, I would miss their presence after all. Without this study, I will probably miss the presence of so many other students I will meet too. (Reconstructed quote in Researcher's Journal, 11/7/2003)

She also expressed her respectful thanks to me because I had not asked what she should do for me and waited until she naturally realized what I brought to the classroom. Thus, trust was established based on our ontological experiences of respect and caring for each other's life, and it paved a road for us to create a richer shared meaning making stories of all the participants.

After these two incidents, Jinju participated in this study as an expert. First, based on the changed attidude, she became far more actively engaged in children's individual growth by caring for each child's personal feelings and thinking, touring each child's table, and providing feedback and praise from her inner heart.

Second, Jinju provided me with deeper insights into the children, the contexts, and the interactions occurring in the classroom. As a researcher, my understanding was deepened with her understanding of the complex classroom contexts. It was more helpful that she talked more about each child's personal stories in relation to the way she was changing her identity as a teacher.

Third, Jinju also positioned herself as the main character in this study as a curriculum planner. She initiated three important reflective activities: STS practice journal, science fiction writing, and cooperative artwork. Particularly, STS practical journal became the single most important cornerstone of this study through the fusion of reflection and action, enabling children to internalize their reflective activities as self-reflective practices.

Fourth, based on her idea, 'this research is mine and children's,' she led this study based on her purposes and philosophy. It was our second STS issues meeting (11/8/2003) that Sora told us that she had been receiving emails from the commercial sex sites steadily. Sora happened to open the adult sex websites by mistake but, later, she said she came to have a mind of opening those websites because of her curiosity. After listening to Sora's story at the STS issues meeting, Jinju did a small survey on how children were exposed to adults' websites, and she found almost all children had seen those websites. Jinju took children's excessive exposure to adults' websites quite seriously, and she separately delivered a special lesson, Netiquette, on how to use Internet in right ways.

Sadako Sasaki's Story (11/10)

The purpose of this activity was to provide children with a reflective space in which they 1) come to know how society impacts on the misuse of science and technology and 2) come to learn how to live with others in different countries in the age of technology and globalization.

Jinju and I went to a big bookstore in downtown in one of the major cities in Korea to buy books for children's STS reading. At the children's corner in the bookstore, an interesting book caught my eyes. The original English title is *Barefoot Book of Heroic Children* written by Rebecca Hazell. I carefully read all the stories and found a wonderful story about Sadako Sasaki. Sadako was the victim of leukemia from Hiroshima Atomic Bomb. She had been a very healthy adolescent before she was hospitalized from leukemia. In the hospital, Sadako remembered a Japanese saying that if a person makes a thousand paper cranes, the gods make one's dream come true. There was another 5 year old girl who was suffering from leukemia in her room too. That little girl developed leukemia from the Hiroshima Atomic Bomb when she was inside her mother's womb. Sadako started to make paper cranes out of her wish for healing her body. But a hopeless accident happened. The 5 year old girl in her room passed away. Sadako saw the peaceful face of the little girl at the funeral and, that night, she went up to the top of the hospital. She looked into the sky and imagined that little girl becoming a twinkling star. Then, Sadako ended her desperate wish of healing her body. Instead, she made a new wish for world peace. She again started to make new paper cranes with the hope of world peace. Everyday, she prayed that no one life in this world would be harmed by war any more. But this world did not give her much time. She died on the day of October 5, 1955. It was when she had made 634 paper cranes. Many of her friends made the other paper cranes and put those in her coffin. Sadako Sasaki's story has been remembered in many countries around the world as a real heroine of world peace.

From Hatred to Love

As soon as the class started, Jinju, showed the pictures of atomic bomb, the ruined city of Hiroshima, collapsed buildings, and dried tangerines. She, then, asked some questions until she got the words such as 'radioactivity' and 'deformed child' from the children. By the time she heard those words, she said, "I will tell you a story about a girl who was harmed by radioactivity. This is a real story that happened in Japan. I hope you listen to this story by imagining you are right there in her room" (Class Recording, 11/10/2003). She started reading the book by saying, "This room is a dark, scary hospital room but a room filled with mysterious colours dancing. Hundreds of paper cranes are hanging down the ceiling…"

Despite Jinju's good introduction, however, the class became noisier, and many children, particularly, girls, did not pay much attention to the story. It was weird to see girls not paying attention to Jinju's story telling because I noticed they loved listening to Nobel's biography three times already. Jinju had to stop to get children's attention three times. However, the children started to concentrate on listening to the story right after they heard that Sadako got leukemia from the Hiroshima Atomic Bomb. Children continued to concentrate on listening to the story, and they finally became silent right at the moment of listening to Sadako Sasaki's death. They all clapped their hands when Jinju closed her book.

Jinju led a whole group reflection until the end of the first class. In the second class, each child received a coloured paper and started to write either a poem or a letter to Sadako Sasaki. The classroom was soon filled with light music. Jinju toured around the class and encouraged their writing. After the whole class finished their work, children had a time to read their poems or letters in a whole group setting, and they discussed ideas and feelings about each child's writings. After the class, she mounted all the poems and letters on the children's work board at the back of the classroom. Each child received a reflective post-it from Jinju, read each one's work, wrote reflection on their post-it, and mounted it on the work they were interested in most.

The followings are some of the children's letters:

Dalai:

> To Sadako Sasaki
>
> How are you?.. I am Dalai living in Korea. The book having your story drove our class into a touching impression. I wished your little 'peace' [story] and the child wouldn't happen to you all, but more and more children are appearing who suffer more than you did [now]. Innocent children and adults are dying because of the oil struggle between the United States and Iraq. Even if nobody wants this kind of war…
> I will write again with a mind of joy and happiness when your dream comes true…
> 2003. 11. 10. Mon.
>
> On a day that something seems to be accomplished
>
> Dalai in Korea (Children's Work, 11/10/2003)

Based on our collective interpretation, Dalai was one of the most capable children who were able to catch the social issues of science and technology in Jinju's class. Dalai said she related Sadako Sasaki's story to the war in Iraq because she frequently had seen innocent people dying in Iraq.

Chosun:

Dear Sadako Sasaki:

I am Chosun living in Korea. Your country and our country are enemies to each other. Your country ruled over our country for a few decades. So, even if I heard that there are good Japanese people, I didn't even try to believe it is true and I hated Japanese. But today after I listened to your story, my thought has changed. I've come to know that there are good-natured people in Japan who are truly concerned about the future. In fact, I tend to avoid the people who have leukemia with the mind that they are ugly and strange. And I didn't feel any kind of pity toward the people whose head became bald and the people who suffered from the pain. But after listening to your story, I feel like I could become just like those because North Korea wish to unite North and South [North Korea and South Korea], and wish to rule over our country by force. If we fight each other, we might be suffering from the nuclear weapons more that you did in your country. I wouldn't have thought of others, if I had become ill from leukemia. How come did you think of flying paper cranes? I wouldn't have thought it, if I had been like you. You wished but couldn't make your wish come because you needed 366 paper cranes more to pray. But your friends and many other countries [friends] in the world are still making paper cranes. Do you feel good? But there are many who cry for world peace but there are few who take actions for it [world peace]. I hope everyone take an action personally in order that your death does not become nothing and nobody die like you. Don't you think? I will be there where you are now some time, but here I will inherit your thought, and I will become a person who thinks of others well. Good-bye Sasako.

- Chosun - (Children's Work, 11/10/2003)

While listening to Sasaki's story, Chosun positioned herself in the imagined hospital where Sadako lived and she repositioned herself with some moral insights both in two Korean contexts: her past life experiences with the people who had leukemia on TV and her present life with North Korea's nuclear threat. By imagining her past life, she was transforming her moral self in such a way that she should care for others more as Sadako did. By imagining her present life, she was building her moral viewpoint that people should take action to avoid wars.

It is interesting that there are four children who expressed their attitudinal changes toward Japanese people after this activity: Chosun, Sora, Hana, and Gangmin. They all wrote about their antagonism toward Japan at the beginning and talked about the changes they made after listening to the story. So, I asked how Sadako Sasaki's story had changed their thoughts. Chosun said:

> When I read history books, Japanese invaded our country and troubled us, and they still claim Dokdo Island [an island claimed by Korea and Japan] as their land… I've never believed that there is a good person in Japan no matter how much people say that there are good people in Japan. But I've come to know that there are people who make efforts for world peace in Japan too. I will consider why [they do] when Japanese people do bad things, and I will judge a person after I think in that person's position from now on. (Field Note, 11/13/2003)

Sora said:

> When I read Admiral Lee [he is the most famous national hero in Korea who defended Korea from the Japanese massive invasion in 16th century], Japanese people killed so many people in our country… and stole ceramics [from Korea]… I hated everything about Japan. I tried my best to believe she [Sadako Sasaki] would not be different from anyone else [in Japan] even if there are many good people in Japan… But now I will see people bad only if they do bad things, and I will see people good if they do good things. I will judge people after hearing their stories first. (Field Note, 11/13/2003)

Sora told me that she wanted to avoid listening to Sadako Sasaki's story, and this was the reason she tried her best to pretend to play with other girls at the beginning (Field Note, 11/10/2003). Hana and Gangmin also told me similar experiences (Conversation, 11/14/2003). By these conversations, I found two commonalities. First was that they would judge people in a more careful way. Second was that they would blame Japanese government rather than Japanese common people.

Miok:

Sadako Sasaki

> Sadako Sasaki! Hello! I am Miok who listened to your story. I felt so sorry after listening to your story. That atomic bomb was a really horrible thing. When we see it taking so many people's lives… However, you thought about world peace, the death of other children rather than your death. You put that ardent passion of your mind in the paper cranes. Your mind of caring for others is really beautiful. **You must have passed away with a mind of wishing your dream come true even right at the moment of your death.** I will desire for world peace too from now on. I will put my mind in paper cranes some time like you… Let me say Goodbye.
>
> From Miok (Children's Work, 11/10/2003)

In the above letter, Miok says that she feels beautiful about Sadako Sasaki's mind of caring for others. Her imagination in bold is very touching and real. Her writing shows us that Miok's knowing happened in emotional, aesthetical, volitional, and rational dimensions.

The followings are some of the children's poems

Eunhee:

Because of One Thing…

Like animals and plants die of tiny spark
Like a little argument becomes a big fight
I feel sorry for
The many dying people

Deformed children are born
From one atomic bomb

People made 1000 paper cranes
To soothe the pain
But it was after the atomic bomb exploded

Imagining people dying from that one thing

Isn't there any other way?
Can't people stop now?

Don't we have any other ways but to see
The images of sadness and pity
With our two eyes? (Children's Work, 11/10/2003)

Chosun told her reflection on Eunhee's poem to the class in a whole group discussion by saying, "I can read Eunhee's strong mind that we must not sit as a spectator but must take action over the problem of losing innocent people because of the atomic bomb. (Class Recording, 10/27/2003)

Chulsu:

War and Greed

Devilish War
Who provoke it?

Surely Surely
That's people's greed

People's greed
Greed is our enemy

The big criminal who kills people
Is greed

We pray for the little and big lives on earth (Children's Work, 11/10/2003)

While children were writing poems and letters to Sasdako, Chulsu's poem stopped me and drove me to ask, "Why did you write 'greed' here?" (Field Note, 11/10/2003) He responded, "I think wars break out when people couldn't control their greed to themselves." It is interesting in his poem that he criticizes people's lack of controlling their greed rather than shows antagonism to people. I also asked, "What do 'the little and big lives' mean?" He answered, "They mean animals and plants." He said he put plants because of the picture of the dried tangerine Jinju had shown at the very beginning of this activity. Dalai put her reflective post-it on Chulsu's letter and it says, "Chulsu expressed well that people's greed drives people to engage in a war." Geunho's reflective post-it says, "From now on, people should learn how to control their greed."

Bin:

War and Bomb

'War'
By this word
Innumerably many people are dying

At this moment
Somewhere on earth
An innocent person is dying painfully

'Bomb'
By this word
In a minute, or even in a second
It took away the lives of many people

At this moment
Now somewhere on earth
An innocent person is becoming ill. (Children's Work, 11/10/2003)

Bin was the first child among all the children in Jinju's class who wrote the negative aspect of science and technology in STS journal (STS Journal, 9/30/2003). In her journal, Bin wrote her memory of Yugoslavian children who lost their home and parents by an air bomb attack from a newspaper a few years ago. She said war took all things from these children and drove them into misery. She was especially sympathetic with the innocent people who died from wars.

Jaemin:

Little Hope

Despite any crisis people face
There are people not losing their hope

When darkness casts over in the sky
Like the shining stars

Despite any hardship
There are people living by a little hope

Don't lose your hope
Have a faith

Out of the unbreakable faith and hope
You will see happiness…
Hope is…
Faith is… (Children's Work, 11/10/2003)

I was so curious about his two words: hope and faith. I asked where he got his ideas of using these two words when he was about to finish colouring his poem. He said, "I got the idea from Sadako Sasaki's minds (Field Note, 11/10/2003)." I asked, "What kinds of mind are they?" He said, "Sadako Sasaki lived with the little hope of seeing world peace by making 1,000 paper cranes, even if she was hopeless before death." I asked, "What about faith?" and he answered,

> Sadako Sasaki did not lose her faith of world peace. That's why she continued to write peace messages in paper cranes and folded them until she died. So, I hope people in crisis would live with the hope and faith of Sadako Sasaki and don't lose their hope and faith no matter what difficulty they face. (Field Note, 11/10/2003)

During our regular meeting after the class, Jinju and I enjoyed talking about each child's poem and letter one by one. We especially liked Jaemin's poem because he read the internal wills of Sadako and related it to the hope in his poem in such a way that people in crisis would live with the hope and the faith Sadako Sasaki carried to her grave. Miok read this story more in an aesthetical way by expressing Sadako Sasaki's beauty of caring for others. Dalai, Chosun and Chulsu read this story more in intellectual ways because they related this story to social problems such as war in Iraq, tension between Korea and Japan, and people's greed and war. Additionally, Eunhee and Bin read this story more in emotional ways because they expressed their strong sympathy toward innocent people dying from wars in their poems. As we see in the above examples, every child responded to this reflective activity in different ways, according to their different personality, ability, interest, and prior knowledge. But one thing in common was that they all created their own desirable humanistic values from learning through reflection such as human dignity, dialogue, respect, and caring in one way or another according to their different personality, ability, interest, and prior knowledge.

Reflection and Children's Vision on Humanity

We saw how much Sora and Chosun tried to avoid listening to Sadako Sasaki's story only because Sadako Sasaki was Japanese. But we also saw how Sadako Sasaki's story drove them to change their attitudes toward Japanese. Sora and Chosun's stories as well as Bin's story (Becoming a Reflective Child in Chapter 4) clearly shows that they tried not to blame common Japanese people whom they did before this study. On the contrary, they blamed the Japanese government which caused a war and, thus, misled common Japanese people to go into the war. Bin and Chosun (later in STS Journal in this chapter) said common people easily become the victims of their misleading government, and Bin even expressed her strong sympathy for the Japanese common people who were forced to kill Koreans by the Japanese government.

In Chapter 3, I showed an American teacher's lesson on Brazilian deforestation (Value Criteria in STS Education). She posed a question of suggesting loan forgiveness or boycotting Brazilian product as two policies of preserving rain forests in Brazil. It seems evident that she posed the question based on American national value criteria rather than global values.

However, educators need to work on positioning community values such as national values in the realm of humanistic values. First, it is because STS issues are becoming more serious global issues (Waks, 1999; Hallak, 2000) all nationalities should work together. Second, it is because STS scholars need to work on a more serious task of the social, economic, and political understanding of the misuse of science and technology (Sokal, 2001) to enable children to cope with more global, powerful, complex, and pervasive existential conditions of science and technology in the their age of globalization and technology. Global warming, depletion of ozone layer, and deforestation are all global STS issues. But healing those STS problems requires us more to understand the internal dynamics of socio-historical structures such as the dark sides of capitalism and nationalism rather than to develop technical lessons.

Wars are probably one of the best representatives of all scientific and technological misuses. At her lecture at WestCAST Conference, Noddings said wars must be avoided because they can be avoided (Researcher's Journal, 2/17/2003). How can we avoid wars? I found a possibility of avoiding wars from the reflective experiences made by the children above. Even if these children hated Japanese, they reached unavoidable moral viewpoints that Sadako Sasaki was the real innocent victim of wars and that she was a genuine carer for world peace. Bin's, Chosun's, and Sora's stories provides educators a possibility that education can do more than it does as the value transmitter of our mother society. As Friere (1971) envisioned for education's dynamic role of transforming the dark sides of our society, I believe education can become a fundamental dynamic of transforming the immoral socio-historical structures which continues to produce and reproduce the negative aspects of science and technology. I also believe that the vision of transforming the immoral socio-historical structure is best achieved by educating children to have reflective moral capacity to cope with their existential conditions of science and technology based on humanistic values. This is the reason I suggest society-based STS education, humanistic values, and children's existential moral capacity as the places of teaching STS issues in schools by overcoming the boundaries of science, technology-based STS education, and national value criteria, and subject based curriculum.

Participatory Inquiry into Technologies in Our Community (11/22, 12/16)

The purpose of this activity was to provide children with a reflective space in which they come to know the negative aspects of technology in their community and gain insights to how to use the diverse technologies they were exposed to in their daily life. First, children were asked to choose a serious problem spot they had often noticed in everyday life. Second, they went to the problem spot, mapped the place, and wrote the problems and ideas of how the place should be changed in their STS journals. In class, children made their own presentation materials with carbon papers in small groups. They drew the picture map of the problem spot, wrote problems and ideas of improvement, and finally put their final reflection.

Becoming a Critical Neighbourhood Watcher

Bomi drew a picture explaining the problems of a small park on her way home. She described this small park as a gambling place of old males full of garbage and bad smells. She wrote:

> Here, this park is the place in which grandfathers [Korean children call all old males grandfathers.] drink liquor [In Korea, it is not illegal to drink liquor outside], do gambling, and sleep. And all the garbage [in this park] comes from these grandfathers who live there for all day long [during the day].

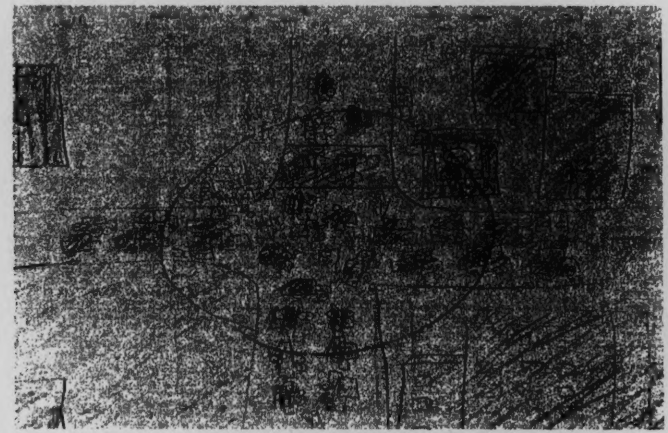
She also wrote her reflection as follows:

> Today, even if the number of old people increases steadily, there are little welfare facilities for the old people. This is why they enjoy talking to each other and spend their time in doing gambling in this resting place. But because there is much garbage thrown by them, people must breathe in bad smell when they pass by this place. I have to hold my breath when I pass this place too. I hope everyone would make effort to make our community environment cleaner and better. (Children's Work, 11/22/2003)

She perceived a bad image about the old people in the place because the park is a public place where anybody has a right to rest (Conversation, 11/24/2004). She said people simply could not rest because of the presence of the old people and the garbage they produced everyday. However, she had somewhat sympathetic feeling toward them and said that the old people do such bad things because they do not have their own resting places. She recommended that the city should build a recreation centre for these people.

Gyungsu's presentation material is quite different from Bomi in that he described a moment of his experience of coming back home from his learning at a private institute while he was crossing a busy street with his friends.

Figure 8. Gyungsu's drawing of crossing a busy street



In the above picture, the four way intersection gets very crowded with cars and people in the evening. The two men crossing a street are Gyungsu and his close friend, and they are running toward the other side of the street on their way home. He put words in the picture such as, 'Honk, Honk,' 'Hey, you! Hurry up,' and 'Go faster.' He put a simple reflection on the back of this presentation material as follows:

> Today, people honk all the time and use many bad words by yelling to each other while driving. I become stressed with all the cars in traffic jam and the noises they constantly make. People become more and more impatient because of the cars and traffic jam. That's because of the development of science and technology.

I learned an insight from Gyungsu's drawing in that adults' practices of using science and technology constantly shape and reshape children's practices of using science and technology too. Children constantly learn and construct their moral life anytime anywhere in their daily life. I came to think that this is the reason STS education should find a niche in each child's unique life by growing and strengthening each child's existential moral capacities to cope with their lives. By a simple reflection, Gyungsu made sense of his existential conditions of technology, imagined what would be the right moral behaviours on the part of adults, and felt the need of change in the immoral structure made by the development of science and technology. Gyungsu suggested that the city should improve the quality of public transportation system and the extension work for narrow roads to reduce these problems. (Conversation, 11/22/2003)

Minho chose a dangerous narrow corner of the wall in his apartment complex. Minho said he was about to collide with cars and bikes several times at the corner because people could not see each other. At the moment, Nari raised her hand and told about the accident she had had one year before. Nari said she once collided with a bike at the same corner and had to have a few stitches in her wound. Nari talked about her accident at the STS issues meeting twice and wrote her reflection on her STS journal as follows:

> Although it was not an accident [car accident], I collided with a running bike and had a few stitches. It was terribly hurting. I always put the responsibility on the person who was riding that bike. But after studying science and technology [this study], I've come to know that that was my fault. That's because I did not pay attention to the danger of the place. I walked without looking forward but looking other places. But I've made a new resolution that I would use crosswalks to cross the street. I also will not do drunken driving and speed violation when I grow up. (STS Journal, 11/22/2003)

During her STS issues meeting right after this activity (11/25/2003), Nari said, "Before this study, I only thought that the accident was unlucky. But I now think that I used science and technology in a wrong way." Nari also said, "I came to know that we have many problems in our community. I could find them if I looked into them with a little more attention which I hadn't cared about before." By explaining the pervasive influence of technology on human activity, Franklin (1992) pointed out that all human activity is affected by "the design of the house, by the division of its space, by the location of its doors and walls (p. 11)." As Franklin (1992) stated, Nari became sensitive to how technology pervasively influenced her everyday activity through reflection, and I believe if Nari becomes a civil engineer in the future, she will think about designing the safe walls of a building more from the viewpoints of plannees at the receiving end of technology, not just from the profitable level for her company.

I went to the problem sites and was stunned with their keenness on the problems. I felt I was learning from the children. I took pictures of all the problem spots they found. I also took pictures of several good places in their community such as clean sidewalk, overpass, highway interchange, park, and shopping mall to balance both the negative and positive aspects of science and technology. We prepared for two full scale papers and drew maps for both the positive and the negative aspects of the community. In our second class, 25 days from the first class (12/6/2003), Jinju posted the two maps (one for positive, the other for negative) on the blackboard. Jinju showed all the pictures one by one to the children, and the child who made a reflection was given a chance to glue each picture and to write her or his reflection on the maps. All the children had an opportunity to look at both of the pictures on the two maps and the reflections on them. They also put their own reflective post-its beside the picture they were most interested in.

The following is children's topics they worked on in this activity.

Table 4.

Children's Topics of Participatory Inquiry into Technologies in Their Community

Category	Problems	No.	Key Ideas for Improvement
Noise Damage	Cars	5	Building more soundproof walls
	Construction	6	Ban on construction at night
Dangerous Place	Subway construction	3	More safety guards, equipments
	Narrow road	2	Ban on dumping truck passing
Garbage	Illegal waste dumping	7	Community watch
	Lack of garbage can	5	Securing more bigger garbage cans
	Bad smell from landfill	3	Relocating landfill
	People's violation of separate garbage collection	1	Thinking about public health
Air Pollution	Factory	4	Relocating factories
	Cars	3	Using public transportation
	Dust	1	Planting more roadside trees

Note. No. does not stand for the number of children. Some children worked on more than one topic.

Table 4 *(continued)*

Category	Problems	No.	Key Ideas for Improvement
Lack of Facility	Sports facility	2	City's buying vacant lands to build those facilities
	Cultural facility	5	
Traffic	Congested intersection	2	More traffic police in busy time Widening roads and quality transportation
	Signals out of order	4	Reporting to the authority concerned
	Lack of parking space	3	City's securing public parking space
Health	Sub-quality food sale	2	Reporting to the police
	Food sale in dirty places	2	Thinking in buyers' position
Apartment	Dangerous wall, dirty elevator and stairs, etc.	2	Cooperation among residents
Public Etiquette	Spitting on public benches	2	Thinking about others
Shopping Mall	Excessive vinyl use, traffic jam, Freon gas	1	Using shopping baskets and public transportation

Note. No. does not stand for the number of children. Some children worked on more than one topic.

Reflective Space of Shared Meaning Making

Jinju took this participatory inquiry as the most meaningful activity except the longitudinal STS reflective activities such as STS journal, STS practice journal, and Nobel's biography, planting garlic. Jinju expressed the surprise she found in children's thinking capacity as follows:

> These days, I do not value the calm class anymore which I once valued so much. My attitude toward children has changed a lot these days. I am really surprised with my confirmation that children can think this much in this noisy class. In case of Bin, she explained why the crosswalk she crosses needs signal lights in a third person's

> position so well. She also explained why our city has to buy the vast vacant lot and how to use it for the people in our community so well. (Regular Meeting, 11/22/2003)

Jinju was surprised with Bomi's insight when Bomi addressed her moral viewpoint of why a public park should be used for everyone, and when Bomi suggested her ideas of providing a recreation centre for the old people. Jinju was also surprised with Gyungsu's keenness when he caught a moment of crossing a crosswalk, related it to his existential conditions of technology. Jinju was particularly surprised when Byungsu realized important STS issues from the little moment of crossing a street such as noise problem, people's impatience, and people's practices of using bad languages and related them to the influences of technological development. Jinju was again surprised with Nari's keenness when Nari recognized the small corner of the wall in her apartment complex as part of the negative influences of technology, and when Nari related the bad accident to her bad use of technology rather than blaming the child who inflicted the damage to her at the STS issues meetings.

Jinju reflected on each child's drawing and reflection one by one and reflected on her practices of teaching. She believed that children are always kinds of incomplete beings to be filled with the knowledge she already set. She also believed that children should follow the exact procedure she set beforehand in order to learn knowledge in best ways. She said that she did her best to teach her children well. That was true. I respected her so much because of the professional and caring spirit she showed toward her children. But here at the meeting, she said, "Nowadays, I've reached a conclusion that my former efforts could be meaningless to the children. I think I did wrongly because I always tried to put children's lives in my framed thought." She continued to say that she would rather see children as they are because the more she gave away her authority to her children, the greater the children's learning she found as Oyler (1996) pointed out.

Clandinin and Connelly (1988) wrote that the ultimate goal of education is to grow and strengthen people's capacities to cope with life. Children's lives are theirs, no one else's. The happiness and the struggles they constantly face are all theirs which no one else can ultimately lift it from their shoulders as Carr (1986) believed. This is why children need enough space to reflect on their life as early as possible. Without children's existential reflective capacity, children may easily assimilate all kinds of immoral knowledge as a simple matter of course. Without his space of reflecting on his running on the crosswalk, who would know that Gyungsu might understand adults' use of honking and bad words in the four way intersection as a matter of course?

Interview with a Life Scientist (12/13)

The purpose of this activity was to provide children with a reflective space in which they come to learn the moral experiences of a life scientist by doing an interview with a life scientist, Dr. Min (pseudonym). Dr. Min worked at one of Korea's national institutes of agriculture at that time. He worked on growing a variety of genetically engineered crops for over 8 years. He was invited to our class to share his life as a life scientist. He first shared his brief life history of becoming a life scientist and what he does as a life scientist. After that, he gave a thirty minute lecture on 1) what life science is about, 2) how genetic engineering is done theoretically and practically, and 3) the positive and negative aspects of genetic engineering.

A Scientist on a Trial

Finally children had opportunities to ask their wonders to Dr. Min as a scientist, and, thus, Dr. Min shared his stories of moral concerns he had had as a life scientist. It must be noted that the questions on children's part were not prepared beforehand. The following dialogue happened while Dr. Min was explaining why legal restrictions are enforced on life scientists and engineers.

> *Dr. Min:* It would be good to trust people's conscience, but we can't trust all the scientists because they are also people just like you. So, scientists have to do their research only if they secure stability. And…
>
> *Jaisun (M):* Dr. Min. What do you do to secure stability for yourself?
>
> *Dr. Min:* (Pointing to a plant on TV screen), we raise this plant in a restricted area so that no one else could take it outside. Especially, when we do some experiments on raising plants' power of resistance against viruses, we only do it in a special laboratory.
>
> *Chulsu (M):* Why?
>
> *Dr. Min:* That's because some of the viruses are very dangerous to people and environment, once it is taken outside in a public area. Only if all kinds of stability tests are completed [in a laboratory], we raise the plants in our restricted farmland as the next step. And when they turn out to be safe, we finally distribute them to outside.
>
> *Chulsu (M)*: Who make that kind of decision?
>
> *Dr. Min:* Scientists hold that kind of meeting. During the meeting, we talk about our concerns such as ethics as well as money. Every scientist thinks about the moral issues of scientific research. Once we decided not to do this research because of the expected harms at the meeting, we usually don't do it.
>
> *Sangmin (M):* Is there any difficulty or trouble you have had in doing scientific research?
>
> *Dr. Min:* That's right. No single thing can be achieved easily… It is usually easy to copy what other scientists have already done. But it is very difficult when we do a new scientific research which hasn't been done. While we engage in those kinds of new research, I have to worry a lot because we don't know what harms our research would

> cause before we see the results. That's why we spend much time in predicting expected outcomes and in working in a laboratory in advance.
>
> *Jaisun (M):* Does it sometimes lead to a complete failure?
>
> *Dr. Min:* Yes. It is… But you must not be afraid of failure just like you don't have to be afraid of your single failure on school achievement test.
>
> *Chulsu (M):* What happens when you inject the genes of fireflies wrongly in a plant when you produce synthesized genes? [Dr. Min showed a shining tobacco made by use of the genes of fireflies before.]
>
> *Dr. Min:* If we inject genes in wrong ways, most plants die… (Pointing to the plants on TV) So, those plants went through a number of failures.
>
> *Chulsu (M):* Have you ever made any mistakes, when you do scientific research?
>
> *Dr. Min:* Yes. I can get harm. Whenever I fail, we lose a lot of money…
>
> *Hana (M):* When do you feel proud of being a scientist the most? And when do you feel frustrated the most?
>
> *Dr. Min:* I feel frustrated when I have to throw away all things I worked so hard with. You would know that kind of feeling. (Class Recording, 12/13/2003)

Many other students also asked their scientific wonders too. Interestingly, Dalai asked how radioactivity affects our body because she wondered about how Sadako Sasaki had leukemia from radioactivity (Conversation, 12/13/2003). Dr. Min explained to the class how radioactivity forms deformed DNA structure. Lastly, Jinju asked Dr. Min to give his final speech to the children who want to become scientists when they grow up. Dr. Min said:

> I presume that the future will be brighter. Scientists work on hereditary diseases, incurable diseases, artificial organ transplant, vaccination, aging diseases, and environmental improvement. We [Dr. Min] are currently working on the development of environmentally conducive agricultural fertilizers and chemicals. Science is the study which can provide human beings with help. In the future, the children who have incurable disease will be cured with the help of science. And there is no person [in Korea] who suffers from hunger anymore. Now, we produce too much rice in Korea. It was possible because scientists like us constantly produced quality rice. That's why I am proud of myself as a scientist. However, science will bring us a bright future,

> only if we all humans have a mind of using science and technology right ways for human beings on earth. (Class Recording, 12/13/2003)

All the children gave a big applause to Dr. Min's visit. Dr. Min had a dinner with us on the same day. He said this was his first lecture and interview with elementary children (Researcher's Journal, 12/10/2003). He said he was worried whether children would understand genetic engineering and whether they could raise any ethical questions on doing science. But Dr. Min said he felt like he was on a trial because children's constant keen questions on the ethical issues of doing science were deeper and more critical than the ones of university students.

Jinju and I shared our reflections after the interview with Dr. Min (Regular Meeting, 12/13/2003). First, our invitation of Dr. Min seemed to have provided children with an inspiring experience in that they directly met, talked, and questioned a real scientist. Children seemed more inspired by Dr. Min's pride as a scientist than our teaching. I could feel that Dr. Min's single word was very powerful, which I could not possibly make it. Besides, Taijo (Interview, 12/27/2003) and Chulsu (Interview, 12/29/2003) changed their future dreams to becoming scientists after this activity. Second, it was meaningful to both of us too in that the interview with Dr. Min allowed us to understand more about the experiences of being a scientist and doing science, which helped us to value science and scientists. As non-experts in science, all of us had very meaningful experiences from this activity.

Reflection and Endless Possibility of Learning

Chosun kept her busy writing something on her personal notebook while Dr. Min was giving his lecture to the class. On that day, Chosun wrote her reflection on the interview with Dr. Min in her STS journal:

> What I came to know from Dr. Min
>
> I hadn't known what genetic engineering is all about, before I studied with Dr. Min on genetic engineering. Now I've come to know that cloning technology is just a part of genetic engineering. Besides, I've come to know that genetic engineering has both positive and negative aspects for us. Before I talked to Dr. Min, I had only known that the bad part of genetic engineering is its infringement on a person's private life. **But after this interview, I came to know that this is not all. Human cloning can produce powerful people and have them die in a war. That's because cloned humans can be made at any time again, and can be sent to a place of war without much concerns or sympathy for them. Then, countries will be destructed and only their people [citizens] will be killed. I hope this kind of use must be taken away. My hope is that genetic engineering must be used for developing organ transplant.** (STS Journal, 12/13/2003)

In the above reflection, Chosun seems to have a negative attitude on human cloning even if Dr. Min presented both the positive and negative aspects of genetic engineering as fairly as he could during his lecture. This might be because Dr. Min raised the issues of human dignity for cloned humans. Nevertheless, all the imaginations she wrote in bold on the latter part are all hers. A few days later after Dr. Min's interview, Jinju had the children write their reflection on 'how should people use genetic engineering?' We gave four categories: scientists, technologists, business people, and citizens. Chosun wrote her reflections on her STS journal as follows:

> Title: How should people use genetic engineering?
>
> Scientists:
>
> It is true that cloning technology will help human's life in some ways. For example, cloning organ tissues will be helpful to the sick people. But cloned humans probably won't be like how we are such as our genuine feelings. Even if they have feelings, it will be different from ours because they are made artificially. So, I think they [scientists] need to control not to produce humans artificially. On the contrary, scientists should try their best to develop food which helps us to live a healthier life such as seedless watermelons.
>
> Technologists:

> When they are ordered by business people to make things out of the products scientists invented, they should be able to refuse to make things if these are not needed for people. Besides they should try their all-out efforts not to harm human beings' happiness.
>
> Business people:
>
> Business people should not think that the inventions scientists develop are all good. They also should not search their profits first. They should think whether their future products will do any harm to our country and its citizens in advance. And they have to earn a patent in advance and produce it only in our country if there is nothing invented in other countries.
>
> Citizens:
>
> Even if the government allows a technology to be made and sold, people should be aware of its use because it can be used illegally by bad people. People should think deeper whether it is good for him and whether it is good for others and for our country before they buy a technology. (STS Journal, 12/17/2003)

As shown above, Chosun has formed a reasonable standpoint on how people should use genetic engineering. She believed that genetic engineering must be used with careful attention and human cloning shouldn't be allowed to happen. In her STS journal, she expressed one specific example:

> …Suppose you love someone. Then you would probably do because you have some kinds of behaviour or personalities [of the other person] that attract you specially. If many people have same characters, there is a possibility that you live without knowing the way you feel. (STS Journal, 12/19/2003)

Chosun also expressed her ideas of future science and technology a few times in her STS journal. Her best idea was seen as follows:

> I hope other countries as well as our country will live well with the development of science and technology. However, our environment is as important as the development of each country. Therefore, now it is the high time that people should develop the ways of correcting all the problems made so far by the development [of science and technology]. (STS Journal, 12/21/2003)

After the interview with Dr. Min, Chosun searched some more information on genetic engineering and wrote three reflections in a row in her STS journal (12/17, 12/19/, 12/21). Chosun was a very special child in that she had strong patriotism toward Korea. When she wrote and told about science and technology, she was often concerned not only about the development of Korea but also about the wellbeing of Korean people. However, she finally expressed her hope for the wellbeing of other countries on December, 21 in the above example. It was since she learned from Sadako Sasaki on November, 10 that she started to dialogue with the imagined people in other countries. She said she hated Japanese and did not want to believe that there would be good natured people in Japan in her letter to Sasaki. However, after her reflections on Sadako Sasaki's story, she could not resist the undeniable fact that Sadako Sasaki was a genuine victim of science and technology and a genuine carer for world peace. She became conscious of human dignity by understanding that anyone in this world, irrespective of their nationality, could be the victim of science and technology (Letter to Sadako Sasaki, 11/10/2003; STS Journal, 12/13/2003).

I raise a couple of important points with Chosun's experiential growth. First, it was her emotional experience of feeling Sadako Sasaki's story that enabled her to position herself in another's position when she needed a moral judgment. Second, it was the reflective space of our interview with Dr. Min that provided her with a great interest in genetic engineering through which she worked on searching more information on what the dangers really are in terms of genetic engineering, Third, it was her expanded sensitivity to the possible negative aspects of genetic engineering which led her to know that STS issues are global issues and people could be the victims of the misuse of science and technology irrespective of their nationalities. Fourth, out of the expanded knowledge that the problems of science and technology are global issues, she made sense of all the essential humanistic values I mentioned in earlier chapters: human dignity, dialogue, and respect and caring for (the self, others, and nature) among people on earth. Fifth, her moral sensitivity enabled her to create a mind of respect other people in other nations too. Finally, it is important that Chosun's experiential growth was ultimately made by the interchangeable interactions of emotional, aesthetical, intellectual, and volitional dimensions stirred by her own reflective consciousness of what we do, what we did, and what we should do as humans to cope with our existential conditions of science and technology.

Surely, her short journey as a self-learner from November 10 to December 30 was dramatic enough to surprise us. My surprise reminded me of Carl Rogers' belief in children's learning capacity one night. I read his wonderful story with young children again and again. Rogers (1994, p. 300) said that "they [young children] are learning, learning, learning—probably at a rate they will never again equal…" As Rogers (1994) saw that the possibilities of learning are almost endless, Chosun's self-reflective learning seemed to have grown endlessly as a responsible global citizen of using science and technology for the self, others, and nature based on her concerns on the negative impact of science and technology on humanity. What we did was only to provide a reflective space in which children could feel something, value something, respond aesthetically, act intelligently, and thus grow morally (Connelly and Clandinin, 1988) based on their unique personality, ability, interest, and social setting.

Science Fiction (12/16)

The purpose of this activity was to provide children with a reflective space in which 1) they could imagine their moral selves and their existential conditions of science and technology in 2030, and 2) come to learn insights of how to cope with their future lives from their imagination. This is the year these children become 37 or 38 years old. The idea for this activity came from Jinju who has strong language arts background. She brought a science fiction written by her former student last year. The title was 'My life in 2100.' This science fiction was written in a diary form and it describes his everyday life with an alien. With careful examination, we reached a common understanding that children would not possibly be able to describe the moral issues of science and technology if they work on their imagination in 2100 because that year is rather much beyond children's experience. Thus, we gave a 27 year gap to the children based on three reasons. First, if we give far more than 27 year gap, children may have difficulty in catching their plausible and practical imagination on their life with future science and technology. Second, if we give far less than a 27 year gap, children may not expand their imagination beyond their present contexts. Third, we judged that the year of becoming 37 or 38 would be an interesting moment for the children because it is the time they probably will get married and work hard in their worksites. Jinju did a practice lesson for this activity two weeks before the real lesson in which children drew a science fiction picture. After their drawing, children wrote a short reflection and children exchanged their reflective post-its too. Children were also encouraged to read the scientific information on future science and technology we prepared during their self-study time in the morning three times. The topics were cyber organism, automated machine, organ cultivation, electric cars, superconductor, and nuclear fusion.

On the day the real lesson was done, Jinju had her children sit at the centre and read her former student's fiction, 'My life in 2100,' to the children. After reading the fiction, Jinju encouraged children by asking, "What is it like living 100 years later? The following was a dialogue after this question:

> *Sangsu (M):* There should be robots.
>
> *Jaisun (M):* We won't have to do military service. [Korean males need to complete two years of compulsory military service.]
>
> *Sora (F):* We won't go to school.
>
> *Teacher:* Well, Don't go too far this time. What is it like living in 2030 then?
>
> *Sora (F):* It would be similar.
>
> *Teacher:* How old will you be? (Class Recording, 12/16/2003)

Children seemed very excited with this topic probably because they would think that they already had enough knowledge to position themselves in their imagined future with more advanced science and technology. The class went calm except the time they shared each one's fiction at the latter part of the lesson. They fell into their imagination. Because of the smooth going, Jinju and I also could stay calm and enjoy reading their science fictions.

Reflection and Three Witnesses of Being

Dongseo wrote about his robot friend:

> I now live with my robot all the time. He [or she] does all my house chores, does research, and play with me. We have built a great love. That's right. He is my real friend. When I become sick, he takes good care of me. When I have something joyful, we share things together. I want to share all my life with him. I care for him and he cares for me. This is exactly how I did with **my friend** when I was young… This robot

> has been always helpful to my life. When I need to meet my old friend, my robot contacts my friend and shows me. Of course, by visual communication… One day, however, my robot was out of order. My parents ordered me to throw him away. But I hated to do that, because we had built such a nice friendship. Throwing away my robot was just like throwing away the dead body of **my best friend** to me. But I lost him at the end. When I threw him, I decided that I would never buy a new robot in my life. My robot friend left a deep sadness to me. (STS journal 12/26/2003)

In his book, *The Age of Spiritual Machines*, Kruzweil (1999) described that, in the year 2020 AD, the memory and computational skills of computers will exceed the ones of human brains, which will ultimately lead to the world of human's automated personality and personified machines. There is a strong possibility that people live with powerful automated machines in 2030. People will probably talk to them, ask for help from them, and, thus, find life meanings with them like the way Dongseo does in his fiction.

Dongseo said his plot came from his reflection on how robots would influence his life in the future (Conversation, 12/26/2003). 'My friend' and 'my best friend' in the above fiction stand for Hana. Dongseo usually stayed calm in his class hours and rarely talked to Jinju in school. He also did not go along with other peers except Hana. This was the reason Jinju often lost sight of his presence in her class. Dongseo spent most of the school hours with Hana. He often faced difficulties in doing his work at school. Nevertheless, Dongseo felt safe because he had a very kind and capable friend, Hana, who would help anytime whenever he was in trouble with his class work. Hana was probably the most precious being who would witness who Dongseo was in his life because Dongseo was living in a harsh living condition at that time. In the above fiction, Dongseo relocates his experience with Hana in his future context and imagines his meaningful storied life with his robot as he was doing with Hana in his present context. Suppose we are currently seeing Dongseo's life with his robot in 2030 as a spectator in his fiction. What drove Dongseo to live a meaningful storied life with his robot? We can presume that his friendship with Hana can be one of the driving forces which have influenced Dongseo's meaningful life with his robot in 2030. In 2030, Dongseo thinks that throwing away his robot is just like throwing away his friendship because his robot means a kind of witness of his being. Under his parents' pressure, however, he decided to obey his parents, but he also decided not to have another opportunity of buying a new robot which may cause him to throw away his friendship once more. By positioning himself in the imagined future with his precious past and present reflective experiences with Hana, Dongseo goes through another reflective process of building his moral self with his existential conditions of science and technology in the future. Back to the present moment, I saw how much Dongseo could live with joy, safety, and meaning with Hana's caring, and Hana's caring not only enabled Dongseo to cope with his existential conditions but also empowered him to value friendship in his fiction. Based on my judgment on his science fiction, I came to visualize how much caring empowers a child to lead a good storied life with one's existential conditions of future science and technology. I presume that Dongseo's struggle with his robot in 2030 will probably come to him some time in the future in similar ways, and I hope he will remember his reflective awareness he made twenty seven years before in his class when the time finally comes to him.

Jinju started to pay attention to the several children she had not done much with before after the two incidents I mentioned at the beginning of this chapter. Dongseo was one of them. Jinju's interests in these children came from her conscious reflection on who she is and who she was as the teacher of these children the unique values of whom she had frequently lost sight of. However, Jinju actively toured all the children's desks and helped each child more than she had done after the two incidents. Jinju once saw Dongseo sitting silently concerned probably about what he had to write with his pencil in Korean language arts class (Regular Meeting,11/10/2003). Jinju helped him to think about a writing topic by suggesting a few ideas. Later, when Dongseo came back to her with his work proudly, Jinju not only found he did a fine job but also found her ideas were threaded into Dongseo's writing in a nice way. Jinju found that children's silence neither means that a child does not think nor means that a child does not need any help from her (Regular Meeting,11/22/2003). Dongseo responded to Jinju's caring by asking help from her sometimes. It was even more an inspiring moment to see him proudly showing his work oftentimes to Jinju. Dongseo's sincere response became a shocking impression to Jinju again. As time moved on, Jinju had to go through more and more emotional turmoil of defining who she is as a teacher of these students. Thus, her reflective experiences with these children, especially on her experiences with the several children she frequently lost sight of, enabled her to have a habit of touring all these children's desks to become an active helper and carer. This also means that Dongseo has another witness of who he is in school. That is Jinju.

Library and Classroom as a Combined Reflective Space

Sangsu positioned himself in a wider social dimension as he wrote his science fiction:

> I am now 39 years old. [Korean age is one or two years more than the western counterpart.] I was lucky enough to have a same sex marriage because of the technological development in 5 years ago. So, I married my best friend, Suman, and adopted children. I am currently raising those children. It is a piece of cake to adopt children these days because there are a lot of children housed in orphanages who were abandoned by divorced people these days. My son's name is Mac. He doesn't go to school. There are teaching robots which explain the wonders to my son well in any facilities. And I am ready to go out any time. That's because space change technology

> is possible. But space change is not possible when the other counterpart does not allow me to do that because it can violate the privacy of the other counterpart. Besides, today, we use solar energy. A big machine is located near the sun and it absorbs solar energy and transfers it to the earth. **Nowadays, scientists have been working on developing cyber humans intensively. But there were a great many tragic deaths of cyber humans due to the mistakes of scientists. That's why scientists are doing research on producing them both effectively and safely...**
>
> Now, I will tell you what is happening at home. At home, robots recognize and perform what I say perfectly. I also can operate all house electric devices by using my cell phone. For example, when I press No. 1, it recognizes my voice. When I press No. 2, it recognizes my body temperature and adjusts the temperature of my room. Besides, we do not have incurable diseases anymore. Even if we have some kinds of diseases, we do not need to worry at all because today's technology makes those diseases inactive...
>
> I came back to my world and asked my computer what I would need to do today. Then, my computer organized my schedule. First, **scientists were worrying about the bad results of their inventions.** So, I went to the scientists by use of space change technology. Those scientists were investigating a cyber human. I stepped back because the cyber human was very scary. After noticing me stepping back, the scientists started to explain things about the cyber human to me. 'This cyber human is for the police.' 'It was supposed to patrol at night only.' 'It has some functions' 'The eyes shoot beam to the targeted people and chase them.' They [cyber humans] actually took people to the police station and put them under investigation. But I thought to myself that even if this is a safe way of catching criminals, it can harm people. That's because these cyber humans can catch innocent people too. Actually there were some demonstrations happened because of this. **But scientists did not change their opinions.** And the marriage between different sexes started to decrease since the time when same sex marriage became possible. To make matters worse, the people who were married even before this technology are getting divorced more and more. As males and females were divided, our united Korea was disunited once again. Females occupied North Korea while males occupied South Korea. There are a great many harms indeed because of the development. (STS journal 12/26/2003)

At the final interview (12/29/2003), I asked what the key ideas were in his fiction. Sangsu's main ideas in his fiction were to describe both the positive and the negative aspects of future science and technology. He predicted that future science and technology would bring more benefits to home life but would bring more harm to society. In his fiction, Sangsu, first, recognizes a few home technologies: teaching robot, speech recognizing robot and cell phone, and computer. He got all these topics from the scientific information on future science and technology we prepared for, but the contents of teaching robot, cell phone, and computer are all from his imagination. He describes home technologies in positive ways as he said to me.

Second, Sangsu recognizes several technologies which cause social issues: sex change technology, space change technology, solar energy, cyber human, and medical technology. He got the topics of solar energy and cyber human from the scientific information on future science and technology we prepared for too, but the other topics are from his life experiences such as science readings and watching movies. However, the contents of all the topics are all from his imagination.

I summarized Sangsu's descriptions of the social issues with the technologies as follows:

1. Sex change technology: increase of divorce rate, increase of orphans, and struggle between women and men.
2. Space change technology: violation of privacy.
3. Cyber human: tragic deaths of cyber humans due to the mistakes of scientists, catching innocent people by mistake, and subsequent people's demonstrations.

Even if space change technology is a bit far from his life in 2030, his imagination seems quite real and probable particularly in sex change technology and cyber human. As he said, "there are a great many harms indeed because of the development," he seems to presume that the negative aspects of science and technology are ultimately unavoidable and, thus, he positions human beings in a continuum of struggling with the negative aspects of science and technology. An important point I raise here is that Sangsu deals with future STS issues more as moral and social issues embedded in people's personal and social contexts. He neither sees that STS issues are the mere results of some technical failures nor sees that solving STS issues depends on scientists' technical solutions. He also positions scientists in that struggle too as shown below:

> 1. Nowadays, scientists have been working on developing cyber humans intensively. But there were a great many tragic deaths of cyber humans due to the mistakes of scientists. That's why scientists are doing research on producing them both effectively and safely…
>
> 2. Scientists were worrying about the bad results of their inventions.
>
> 3. But scientists did not change their opinions.

Sangsu sees that scientists are also humans who influence and are influenced by social values as many philosophers and sociologists of science stated in Chapter 3 (Sassaower, 1997; Longino, 1990). Sangsu describes that scientists worry about their inventions, make mistakes, try to invent safer and more effective inventions, and sometimes do not change their opinions. His learning about who scientists are, and what scientists should do did not come from this simple lesson but came from the constant reflections he made both in and outside of his classroom, particularly from his reflections on Nobel's life, Dr. Min's life story as a life scientist, his practices of using technology with STS practice journal, and science reading in a library (Sangsu's story continues in Nobel's Biography).

At the final interview, when I asked what he learned from writing science fiction, he said he would live a quality life as a responsible person using science and technology in the future. When I asked, "How come did you think that way?" he related his learning to a science book he read in a library near his house rather than science fiction. The title was *Wonders of Life Science.* He said:

> After reading this book, I was surprised with that human beings have gone though the long enduring process of evolution to survive and I came to know the importance of human's life. At the moment, I decided to live a quality life… We owe the evolution

> of our life to our ancestors who died for human evolution. I won't dishonour their priceless deaths for us. (Interview, 12/29/2003):

Sangsu's simple narrative tells many insights to all of us, particularly, to politicians, industry, scientists, and technologists. Sangsu's reflection on *Wonders on Life Science* awakened him to value the priceless deaths of our ancestors for human evolution, led him to value human life, and drove him to decide to live a quality life as a human for his biological and social progress. It is evident that his narrative expressed many of the humanistic values on which this study is based: human dignity, respect and caring for the self and others. I assume that Sangsu would expand his understanding to nature too because nature also has gone through the long enduring process of evolution to survive. His powerful narrative also reminded me of Simpson's, an evolutionary biologist, vision on human evolution. Simpson said (1967):

> We need to balance our knowledge better to reverse the disparity in discovery in the physical, biological, and social sciences so that social sciences shall be first and the physical last. We need to realize more fully and widely that technological advances and the invention and enjoyment of gadgets are not the most useful sort of knowledge and are relatively quite unimportant for true human progress. We need to remember that cultural evolution proceeds only by **interthinking**, as organic evolution does only by interbreeding… It is immoral for any man, industry, or nation to reserve knowledge for its own advantage alone. (pp. 337-338)

By emphasizing interthinking, Simpson (1967) strongly argued that human beings have to build a moral world through dialogue in order not to degenerate human evolution because of the misuse of science and technology. Under the misconception of value-free science, we see how the goals, activities, findings, and products of science have been misused by powerful political, economic, and other socio-historical values throughout the human history such as wars and environmental destruction. We also see how seemingly innocuous technologies such as a sewing machine and organ transplant were misused by people (Franklin, 1992; Jefferis,

1999) in Chapter 3. As Funtowicz and Ravetz (1933) pointed out, we need to position science as a dialogical entity in social and historical dimensions and search the right meanings and dynamics of doing science for true human progress by reflecting on what science was, what science is, and what science should be in nature and our place in it.

By the way, where did Sangsu's thought provoking moral insights come from? The secret was that he had a valuable reflective place outside the classroom. Sangsu is a great reader. He read 25 science books and wrote each reflection in his STS journal during the study, and his most frequent topics were about science fiction and scientific wonders. It was interesting that he had a very special place for reading science books. It was a library right next to his apartment complex. In most cases, he went to the library with his two most loving friends: Suman and Taijo. Sangsu particularly liked Suman whom he is married to in his science fiction. They often went to the library on Wednesdays and Saturdays. Their parents usually had them go to the library and stay there until their private lessons started in the late afternoon on Wednesdays because all the parents were at their worksites until late evening. Sangsu told me about his fun in reading books in the library oftentimes throughout the study. I became very curious about the library, partly because the place helped all these children to read over 20 science books, and partly because the place seemed to provide much meaning to all of the three. I was once invited by the three and had an opportunity to go to the library on December 27. 2003. As soon as we entered the library, they were on their ways to find books to read rather than to guide me. They immediately sat and started to read books. I just let them concentrate on their readings and talked to the librarian for a while. However, these bookworms never stopped reading until I told them to be interviewed. I did a separate interview with each of them in the library. At the interview, I asked "Would you tell me about how you like your reading?" Sangsu said "…When I read books, I can imagine much more than I see movies… Once I start reading books, it doesn't matter where I am or whether people make noise." (Interview, 12/27/2003) This library was where they read most of their science books. Sangsu also said that he is considering becoming a scientist in the future because Taijo, one of his best friends, made his dream of becoming a scientist in the middle of this study. Indeed, the library was a collaborative reflective place of creating shared meanings for these children. Thus, Sangus' deep insights in his science fiction writing do not came from our simple lesson of science fiction writing but came from his reflective learning from life experiences with people, contexts, and interactions both in and outside his classroom. The only thing we did was that we provided a space of reflection in which Sangsu could learn and grow by reflecting on his experiences, and we thought that it was the best part we could contribute to the growth of Sangsu. In this way, both his classroom and the library provided Sangsu with a reflective space of growing his capacity to become a responsible citizen who promotes positive use of science and technology in society. I presume that Sangsu can face some similar ethical concerns the scientists face in his fiction if he becomes a scientist in 2030, and I hope he will remember his reflective awareness he made twenty seven years before in his class when the time finally comes to him.

Collaborative Artwork: Our Ideal Community (12/27)

The purpose of this activity was to provide a reflective space in which children create, what Franklin calls (1992, p. 83), "a plannees'" view of technology by making collective craft artwork of their ideal community. In Chapter 3, by showing how a sewing machine exploited the labour of women, Franklin (1992) addressed that political and entrepreneurial decisions are made on a technical or profitable level far away from public scrutiny. As she noted, I noted that these social problems were not properly examined or predicted for the people at the receiving end of technology before the developments of those technologies.

Eisner (2002), an art educator, emphasized the place of art in human judgment and action by stating that, "work in the arts cultivates the mode of thinking and feeling, and forms of thought integrate feeling and thinking in ways that make them inseparable" (p. 9). This suggests that art can play a role of helping children to create meanings by expressing their thinking, emotion, and volitions through their genuine experiences of art activities in schools. There is a variety of possible artwork for children's reflection such as crafts, drawings, posters, sculptures, photographs, musical compositions, and rewriting songs in art or music classes. In this study, we only worked on craft artwork by organizing the existing art curriculum unit of 'Facilities in Our Community.' In my pilot study, my cooperating teacher, Nara, was worried about both children's and teachers' stereotyped image of artwork. In a normal Korean art class, technique is emphasized rather than the meanings or ideas of children. As a result, Jinju and I told children that the expression of what children think, feel, or hope are more important than the art technique in this study.

Displaying children's artwork encourages children's motivation toward their creative artistic experiences. Children's artwork includes all forms of the results they devote to the reflections on their moral selves and their existential conditions of technology. In this study, children spent a few months in reflecting on the various sorts of STS issues in relation to their community. An important aspect is that the craftworks initiated by these children are different from the ones initiated by their homeroom teachers in that those are their own reflective expressions of their struggles, hopes, and ideas for the better conditions of technology in their community. When an artwork is done expressing each individual's emotions, aesthetic feelings, consciousness, internal will, there is a strong possibility that artwork may help in constructing powerful moral capacities to cope with their lives.

A few days before this activity, Jinju reminded the children of their participatory inquiry into technology in their community and science fiction they wrote to provide children with an opportunity to create key ideas of their collective crafts. Children reflected on the whole imaginative process of their crafts in small group: themes, sketch, materials, and art techniques.

On the day of this activity, children worked on their crafts for 120 minutes, and they spent 40 minutes in reflecting on the all eight crafts they created. Group 1's title was 'Construction Robot.' The children in the first group were Sangmin, Taijo, Mina, and Sunmi. In their picture, a big robot is working on building and tunnel construction. There are also small robots helping the big robot. The small robots are doing somewhat meticulous jobs such as painting, installing windows, or cleaning. There are robots inside the tunnel working on light instalment too. After finishing their craft, the children in this group wrote their collective reflection as follows:

> There were lots of construction workers who got hurt or died while working dangerous jobs. If we develop multi-purposed robots which can do the dangerous jobs easily, people will not be hurt or die while working on dangerous jobs. We got this idea from the development of farming practices. That's because farmers do farming with machines so easily today, but farming was such a hard labour work in old times. (Children's Work, 12/27/2003)

In the above reflection, we can see these children position themselves in three dimensional spaces by comparing people and their existential conditions of science and technology in the past, the present, and the future contexts. This was because the children in this group cooperated with one another better in almost all aspects of their work compared with other groups (Class Observation, 12/27/2003). They particularly addressed the possible positive and negative aspects of robot technology before inventing their robot technologies. Sangmin, as the first initiator of robot technology for their work, presented his group's craftwork in front of the whole class. The following dialogue followed his presentation:

> *Teacher:* You wrote some positive and negative aspects of robot technology.
>
> *Sangmin (M):* Yes. Positive aspects are they do dangerous or dirty jobs for humans. Besides, it will be easy to work. Negative aspects are there will be unemployment problems. And when the electric circuits are out of order, they may kill people and make things very dangerous.
>
> *Teacher:* (Looking at the whole class), let's talk about your reflections.
>
> *Jaisun (M):* It will be difficult to keep that robot in a safe place.
>
> *Suman (M):* What are the other positive aspects of those robots?
>
> *Sangmin (M):* People can ride the robots to operate them. So, things will be more comfortable.
>
> *Jaemin (M):* It will take much time and effort to move the big robot to other places because that robot is too big.
>
> *Dalai (F):* I think that [big] robot can build things fast because it can reach higher up to the top of those buildings. If the small robots work on building interior structures or designs, I think they can build things more beautifully and fruitfully. (Class Recording, 12/27/2003)

It was interesting that Sangmin tried to present the positive and negative aspects of robot technology in a balanced way at first. Even if their imaginations of the positive aspects of robot technology were quite thought provoking, he warned the possible negative impacts of robot technology on society in such a way that robot technology can inevitably bring some kinds of unavoidable negative aspects too such as unemployment and malfunction.

Children's reflective feedback was also interesting in that they critically analyzed the positive and negative aspects of robot technology. As soon as Jaisun pointed out his concern on how to keep the big robot in a safe place, Suman became curious more about the positive aspects of the big robot. Suman asked this question because he sensed that there were more negative aspects of the big robot (Field Note, 12/27/2003). As soon as Jaemin addressed another concern on how to move the big robot, Dalai well expressed both her good imagination of robots working inside the buildings and how their work would turn out positively. As shown, all of the children critically examined the positive or the negative aspects of robot technology one way or another and presented the voices of plannees' concerns on the invention of robot technology.

Group 3 (Seri, Mina, Geunho, and Sungju) worked on this activity from the view of plannees, but their work was a little different because the view of the plannees in Group 3 was the reflective view of their own experiences. Seri presented their work, and Jinju led a discussion as follows:

> *Seri (F):* This is about future city. It looks similar to our city but has many different aspects. This is a photo shop. Fat people go to this place to get slimmer picture of them. Skinny people go to this place to get glamorous picture of them. These places are crowded with fat and skinny people. There are ice-cream machines so that people buy ice-cream and get rid of sweat in hot summer days. This is a big garbage can which can crush all kinds of garbage into tiny flour because there must be so much garbage left by many people… We planted lots of trees, because people can breathe in clean air…

> *Eunhee (F):* I think you made the public phone box so well. But people [using the public phone box] can be damaged by the garbage can because it is right next to the public phone box.
>
> *Miok (F):* Today's camera only copy things as they are. But that photo shop looks very good because it can change our appearance.
>
> *Hana (M):* It seems that if we can change our appearance, the photos can be misused for some other purposes in wrong ways.
>
> *Byungsu (M):* You must have had lack of space. But you planted trees in wrong places. It can cause accidents.
>
> *Bomi (F):* Just right before, you said people throw garbage after buying ice-cream. People throw garbage anywhere today even if they have garbage cans. So, it would look much better, if they put cleaning robots which can deal with garbage scattered around. (Class Recording, 12/27/2003)

As she said, Seri's group chose technologies in their everyday life as the topics of their craft: photo shop, roadside trees, garbage can, ice-cream machine, and phone box. They said their creative results of ice-cream machine, photo shop, and garbage can all came from their wants and needs. They carefully examined and imagined how the technologies at the present should be changed in better ways, and, thus, created their imagined technologies. Eunhee, Hana, and Byungsu added understandings on the negative aspects of the crafted technologies this group envisioned while Miok did on the positive aspects of the photo technology. Bomi went a bit far into the practicality issue of garbage can by exposing adults' bad practices of throwing garbage. Bomi pointed out adults' bad practices of throwing garbage would not make any difference despite the presence of the creative garbage can. She, instead, suggested an alternative method of dealing with garbage problems by introducing cleaning robots. As was with Group 1, these children actively addressed their imaginative mode of thinking and feeling (Eisner, 2002) and, thus, contributed to the creation of collective plannees' views on how technology should serve people.

Group 6 (Chosun, Jungmi, Byungsu, and Gangmin) worked on creating a community in the sea. Chosun presented her group's work and Jinju also led a discussion as follows:

> *Chosun (F):* Here in this sea world community, many living creatures live and we created a nice apartment. This is an institute in which scientists are doing research on restoring dead animals into life. And this is the place where scientists are cultivating endangered living species of our times. Remember I am saying these things in future space and the present is the past. And this is the place where squirrels live. We made this place [where squirrels live] because we can enjoy our life on earth in a sea world community.
>
> *Dolshei (M):* I wish I could live again in that kind of future because I can see the life creatures of extinction.
>
> *Mina (F):* I think you got your ideas from life science.
>
> *Somi (F):* It is good to see that all living creatures live long.
>
> *Jaemin (M):* However, if we continue to restore dead animals, the ecological system in the sea will be so complex and the remains these creature leave may pollute the sea.
>
> *Bomi (F):* Besides that, if we continue to restore life organisms, many of small and big living creatures will flourish. And people's mind of respecting life will be diminishing.
>
> *Chulsu (M):* Jaemin said things will be troublesome because of the remains. But I think our science and technology will develop enough to cure all the problems, if the time comes. (Class Recording, 12/27/2003)

As Mina presumed, the idea of Group 6's craftwork came from Chosun's great interest in life science as I showed her story in 'Interview with a Life Scientist' in this chapter. As she always did, Somi expressed her caring spirit toward animals by saying, "It is good to see that all living creatures live long." It is interesting that Jaemin addressed an environmental concern on the negative influence of genetic engineering based more on an instrumental view of nature on behalf of human wellbeing. In a different way, Bomi addressed the same concern based more on a teleological view of nature on behalf of all living creatures themselves. Chulsu went a little far and suggested an alternative possibility of curing all the problems by using advanced science and technology.

It is interesting that Somi and Bomi, two female children, expressed their respect for life with a more caring voice while Jaemin and Chulsu, two male students, expressed their judgments on genetic engineering with a more justice voice (Gilligan & Attanucci, 1988). The different trends of moral growth between male children and female children were noticed steadily in many occasions throughout the whole study. As you may notice, for example, when Jinju led a discussion, male children tended to lead the discussion to a more judgmental, depersonalized or hypothetical situation while female children tended to lead the discussion to a more emotional, personalized, or experiential situation.

Their different trends reminded me of the importance of caring perspective on using science and technology in human history. As Franklin (1992) pointed out, we see how much our valuable nature and human experiences have been destructed by using science and technology based on the egoistic and instrumental production of technology with the development of imperialism and capitalism. Considering the powerful, pervasive, and global science and technology (Kirman, 1997), it is high time to redirect the egoistic nature of capitalism and community values by educating our children to become critical thinkers and genuine carers for others and nature who can use science and technology based on humanistic values as Bomi envisions in the above whole group reflection.

As Franklin (1992) did with a sewing machine earlier, Jeffery (1999) also showed how organ transplant technology became a social problem in India where over 2000 people sell one of their kidneys to make money to survive every year. It is true that politicians, business people, scientists, and technologists have often neglected the negative applications of science and technology on common people both consciously and unconsciously throughout human history. As a result, common citizens, particularly in the countries in the Third World, frequently have easily become the victims of the negative aspects of science and technology mainly because they have not been fully aware of the negative aspects of a new technology. This is why it is important that all people bring all of their views on a new technology to the table and discuss the proper use of science and technology for the people and nature at the receiving end of technology. As shown above, children's reflective talk not only brought many of the social and moral concerns but also brought better ideas of using robot technology, living technology, and genetic engineering. Indeed, the stories of these children's group reflection tell us that it is important to enable children to form a habit of addressing the possible positive and negative aspects of science and technology, which help them to build a more democratic society.

Nobel's Biography (9/23-12/29)

The purpose of this activity was to provide children with a reflective space in which 1) they felt the storied life of Nobel more as a common person who went through many struggles, pains, joys, and hopes just like they do in their daily lives, 2) felt how Nobel grew with his existential conditions such as people, events, and happenings over time, and 3) felt one's own insights from the experiences of Nobel more as a scientist and technologist and what and how a scientist or a technologist should do for the self, others, and nature. Nobel's biography was useful in my pilot study and reused again in this study.

History brings understanding, insight, wisdom, and outlook to our lives (Dewey, 1966). As history brought out who we are, our future depends on what we do here and now. In this activity, children learned how Nobel created his life by overcoming his existential conditions he faced: his moral sensitivity, moral decision-making, and moral action. As we taught, we tried our best to enable children to feel Nobel as a common person as well as a scientist. We also helped children to reflect upon how Nobel's existential conditions influenced Nobel's life as a person and a scientist over time and how Nobel's life has again affected our society.

Curriculum Design

Moon (1999) and pointed out that children's thinking skill can be improved through intriguing questions and conducive environment. Based on these psychologists' common assumption, we developed clear teaching strategies: First, we chose this book partly because it has many personal stories of Nobel and partly because the reading level of this book is for middle elementary students with many illustrated pictures. Second, we enlarged the original book into a bigger one (43cm X 65cm). Third, we had children sit in the children's work place so that they could listen to and see the pictures well. Fourth, Jinju became a good storyteller to attract children's attention like a radio artist. Fifth, we developed thought provoking questions and led a fruitful discussion. It must be noted that both Jinju and I never judged Nobel's life either in positive or in negative ways throughout the whole study as we did in other reflective activities. The primary goal was to see how each child grows based on their uniqueness.

Procedurally, Jinju and I divided Nobel's biography into 10 chapters and Jinju told each chapter at the beginning of each single STS reflective activity. Thus, telling Nobel's biography had been done 10 times altogether from the beginning to the end of this study.

Nobel's biography was selected as the best meaningful reflective activity by the children (See Appendix 6). Children liked listening to Nobel's biography very much, and they asked Jinju to continue to tell the next chapter of Nobel's biography, whenever Jinju stopped for saving it for another day. Besides, it must be noted that several children already read Nobel's biography but their understanding of Nobel did not seem to go beyond the simple fact that 'Nobel is a great inventor or scientist.'

Jinju was an excellent initiator of any STS reflective activity. She initiated this activity as follows:

> *Teacher:* Class. Do you know any scientist?
>
> *Class:* Edison. Einstein. Nobel.
>
> *Teacher:* Oh! Nobel. Who is Nobel? Would you tell me about him?
>
> *Chulsu:* Nobel donated all his fortune and gives some kinds of award and trophy to someone who does something very well.
>
> *Teacher:* What is that?
>
> *Class:* Nobel Prize! (Class Recording, 9/23/2003)

After a while of introduction, Jinju read the first chapter of Nobel's biography. She led a whole group reflection as follows:

> *Teacher:* I'll stop here for today.
>
> *Class:* Woo. (They tease Jinju to read more.)
>
> *Teacher:* How did Nobel live in his young ages?
>
> *Taijo (M):* Alfred was weak, when he was young. So he couldn't play with other children very well.
>
> *Teacher:* What else?

> *Taijo (M):* He was poor and his father left his home to somewhere.
>
> *Teacher:* Good! Is there anyone who can say more about it?
>
> *Hana (M):* His father was an architect at the beginning but later became an inventor. He later left for Russia, after he found no one who either would buy his inventions or would grow his talents.
>
> *Teacher:* Good. Anyone to complement?
>
> *Jaemin (M):* Because no one would buy his inventions, his father decided to leave his country and go to 'the Rising Country,' Russia [He uses the metaphor used in the book.] to run a business there.
>
> *Teacher:* Oh! The Rising Country! Anyway, why do you think Nobel's father left his country to run a business in another country? [Children heard Sweden and Russia engaged in a war from Jinju.]
>
> *Jaemin (M):* Even if Russia was the enemy of his country, even if he was a scientist, he went to Russia because Russia recognized his talents. (Class Recording, 9/23/2003)

During the discussion, Jinju asked simple or concrete questions first and, then, moved into more thought provoking or abstract questions. Whenever she needed more information from the children, she asked divergent questions such as, "Anyone to complement?" In the above dialogue, children addressed concrete answers such as Taijo's answer, "He was poor and his father left his home to somewhere" at the beginning. Taijo's answer, however, lacked of issues of interaction between Nobel and other people or contexts. Then, Jinju used a more thought provoking question by asking, "Is there anyone who can say more about it?" and "Why do you think Nobel's father left his country to run a business in another country?" Children had to analyze why Nobel's father left his country by Jinju's thought provoking questions. Throughout the whole period of this activity, Jinju maintained this flow of asking questions. By this flow of asking simple concrete questions to more thought provoking questions, we were able to enable the children to form their own standpoints on Nobel's life.

Jinju also asked some concrete questions about the former chapter to remind the children of the basic facts they had heard, right before children engaged in listening to a new chapter.

Besides, Jinju also used another useful question by using 'what if…' Jinju used 'what if questions in two ways. First, she used 'what if Nobel…" which could help children to position Nobel in the unlived lives of Nobel. This positioning helped children to make sense of Nobel's internal conditions and his existential conditions, which, in turn, helped them to feel Nobel's moral struggles with his existential conditions in a more real sense. Jinju led the discussion as follows:

> *Teacher:* How was Alfred's life like in the United States?
>
> *Sora (F):* It was difficult?
>
> *Teacher:* How difficult was it?
>
> *Bomi (F):* He couldn't be able to study because he fell in love with poems.
>
> *Teacher:* What else happened in Nobel's life?
>
> *Minseok (M):* Yes. He met a woman and fell in love with her. But she died.
>
> *Teacher:* Oh. What would have happened when he had married her?
>
> *Geunho (M):* He would have had a few children and become a good father who led a beautiful family.
>
> *Eunhee (F):* He would have thought that it was better to live and die with poems rather than to live as a scientist. He would have read lots of poems to his wife and children. (Class Recording, 10/16/2003)

Second, she used "what if you…" which could help children to position themselves in Nobel's life. By positioning themselves in Nobel's life struggles, this reflective space provided the children with a variety of opportunities to feel Nobel as a common person as well as a scientist and technologist. Jinju led the discussion as follows:

> *Teacher:* Nobel saw the terrible accidents. If you were Nobel, what would you do? [In the story, Nobel invented explosives made from liquid nitro-glycerine, but they sometimes exploded with a little external impact. Accordingly, the explosives caused the deaths of many people including his brother, Emile. Besides, many of his investors forced Nobel to return the money they had invested after these accidents, and he faced going into bankruptcy.]
>
> *Junsu (M):* I would argue with them [investors] and say, 'Why did you buy my stocks?'
>
> *Minsu (M):* I would attribute my faults to them [investors].
>
> *Byungsu (M):* I would give up and run away from them [investors].
>
> *Taijo (M):* I would put a special note on the nitro-glycerine box such as 'Special Danger.' And I would defend myself from the angry investors by signing a completely defendable contract.
>
> *Teacher:* Well, but what did Alfred do? He persuaded the investors and began…
>
> *Bin (F):* I think Alfred did a wrong thing at the moment.
>
> *Teacher:* Why?
>
> *Bin (F):* How come did he continue to make explosives? He had seen enough…
>
> *Gyungsu (M):* I think he has self-confidence. Despite all the troubles, He didn't give up and continued his work.
>
> *Sangsu (M):* That's right. I think he is a really great person. In the middle of that kind of urgent situation, he cooled down himself and persuaded the investors.
>
> *Gangmin (M):* If I were Nobel, I would give up that work and live as a normal person.
>
> *Miok (F):* If I were Nobel, I would give all the money to the investors and start a new job. But he did not simply give it up. That's why he was a man of the great will. (Class Recording, 11/22/2003)

As you may notice in the narratives of Junsu, Minho, and Gyungsu, they told what they would do as frankly as they could by positioning themselves in Nobel's moral struggles, and they probably could find that Nobel's struggles would be harder than they had expected. Taijo, however, went a bit far and suggested a very reasonable alternative to defend him from the angry investors. Bin saw an immoral aspect in Nobel's persuasion with his investors because she interpreted it as Nobel's continuous effort to continue to work on inventing explosives despite the many deaths of innocent people from his invention. But Bin's strong emotional argument was soon challenged by the opposing views raised by the other children, Gyungsu, Sangsu, and Miok. It is interesting that Miok frankly spoke that she could not face the difficulty Nobel faced with investors but respected Nobel for his great will. As shown in the two conversations above, what if questions led children not only to feel and think deeper on Nobel but also to shape and reshape their own moral viewpoints with their continuous process of thinking and feeling.

During the last three periods, a whole class discussion went so freely and actively that children themselves led into a hot debate on the inventions of dynamite, Nobel's intention on his Nobel Prize, Nobel's donation of all his fortune, and the evaluation of Nobel as a person and as a scientist. As you have seen, children learned not only from personal reflection but also from a whole group reflection and, thus, formed their own moral standpoints on Nobel.

Unique Meaning of Nobel's Life in Children's Reflection

Children wrote their final reflections on Nobel on December, 17. 2003. It must be noted that before children wrote their final reflection, Jinju wrote some guiding questions to know more about their reflections to some specific events and happenings in Nobel's life: She wrote five questions as follows:

Consider the following questions and complete your reflective writing on Nobel's life.

1. Is there any relation between Nobel's childhood to his whole life?

2. What if Nobel lived a different life such as foreign study, poems, and first love?
3. What are Nobel's struggles and why?
4. Why did Nobel donate all his fortune and create Nobel Prize?
5. How do you evaluate Nobel as a scientist and as a person?

The following are some examples of the children's final reflections. Sangsu wrote his reflection as follows:

> Nobel became a scientist by his father's influence at the beginning. But he came to do research on extremely powerful nitro-glycerine. Even if his brother Emile died of nitro-glycerine, he continued to make his dream come true by overcoming the frustration. As soon as he invented nitro-glycerine which he believed perfect, he found he was too careless. Many people were killed because they dealt with it carelessly. So newspapers criticized Alfred. Nevertheless, he was not discouraged and continued to expand his dream about science. Finally he invented dynamite. He made dynamite which is not dangerous. He expanded his dream about science despite several troubles. If I had been Alfred, I would have given up all things and lived a peaceful life by doing farming in the countryside. As the same human, there is a really great difference [between Alfred and Sangsu himself]. Wouldn't it be due to his passion, love, and persistence toward becoming a good scientist? I will invest my whole life to make my dream come true as Nobel did. I felt so many things by reading [listening to] Nobel. It must not be an exaggerated word to call Nobel as 'the father or mother of science.' I want to send my applause to Nobel who contributed his whole life to making his dream come true. I would feel really beautiful when I see society which makes efforts. [By this, he meant society will look beautiful when people in it all make efforts to make their dreams come true.] It cannot be compared with any other things. (Children's Writing, 12/29/2003)

Sangsu took this activity in a very personal way, and he was one of the several children who evaluated Nobel's life in very positive ways. He was a critical learner who criticized himself first. He was also an active listener who tried to learn from Nobel rather than criticize him. From his learning from Nobel's biography, he tried to lead a storied life of making his dream come true. In his narrative, Sangsu values Nobel's personal journey of overcoming all the struggles and finally becoming a good scientist. The invention of dynamite is described as the symbol of Nobel's victory over all the struggles. He especially values Nobel's passion, love, and persistence toward making his dream come true. Then, he positions Nobel's respectable life in his life and compares what he is doing. Thus, listening to Nobel's life became a valuable aesthetic experience by which he envisioned his storied life of making his dream come true.

Bomi wrote her reflection as follows:

> Nobel became a scientist through his father. Therefore Nobel did many research and made many efforts throughout his life. If he had been living as a poet or as a novelist, would he have become a useful person for us? I don't think so. That's because if he hadn't exerted his effort to do a research on explosives, we may not have dynamite still and people should have a difficult time in working construction work. Nobel had many troubles in his mind over the scary accidents he saw. In my thought, he seems to have had troubles by his thinking that many people were dying because of the inventions he made. How would I have done, if I had been Nobel? I would have quit doing research on developing explosives. But I think I can find Nobel's intention toward world peace in Nobel Prize. So, it seems that Nobel was a person who made efforts and cared for other people. Now if **people in all countries** make efforts and do research based on this mind, world peace will be accomplished faster. (Children's Writing, 12/29/2003)

In her reflection, Bomi values the inventions of Nobel because they are useful for us. She feels sympathy for Nobel's struggle of seeing innocent people dying from his inventions more than criticizes his continuous endeavour of developing explosives. Most of all, Bomi is touched by Nobel's intention toward world peace and sees him as a sincere carer for other people, which enables her to create her hope for the future science and technology. She believes that world peace depends on all people's conscious efforts and caring spirit for world peace and for other people. She also expresses her hope and concern on future science and technology by saying that doing research contributes to world peace when it is based on caring spirit for world peace. It is interesting that Bomi, by using 'people in all countries,' understands that world peace is a global issue which can be accomplished by the efforts and caring spirits of people in all countries. Both Sangsu and Bomi saw Nobel's life in more positive ways. However, Bomi interpreted the meanings of Nobel's life more for the wellbeing of our society by envisioning her hope for world peace while Sangsu interpreted them more for the wellbeing of an individual's existential pursuit of life consciousness.

Sungju wrote his reflection as follows:

> Nobel's young age seems to have been influenced by his father. If his father had done different works very well, Alfred Nobel would have done different things very well by inheriting [other abilities] from his father. And if Alfred Nobel had lived a different life, he would have married his first love and lived a normal life in an average home. However, because he became a scientist and exerted his full abilities, I think it turned out better for him to become a scientist. But I think he was wrong as a scientist to continue to develop explosives because he already had many people who died from his explosives including his brother, Emile. Why did he continue to develop explosives, even if he would easily expect that many people would be killed by his explosives? Some different people [other children in the class] see Nobel has perseverance. But considering that Nobel seems smart, wouldn't it be all right to invent other things instead? Anyway Nobel didn't spend all of his money away and made Nobel Prize by expecting to have great talented people. It will be a meaningful thing for me to donate money for the world [in the future]. (Children's Writing, 12/29/2003)

In his reflection, Sungju evaluates Nobel's life in more negative ways. First, by addressing his father's influence on Nobel hypothetically, Sungju pays attention to Nobel's social settings and their influences on Nobel's life. He continues to address this issue with Nobel's first love and reaches an assumption that Nobel would not have exerted his full abilities, if he had lived a different life. At this point, he delimits his assumption to Nobel's personal matter and does not expand it to the social consequences of his inventions. However, as Sungju moves into Nobel's social settings, he becomes so critical on Nobel's conscious efforts of developing explosives. His criticism on Nobel's immorality is very clear because, to him, it was evident that Nobel would expect people's misuse of his explosives and the consequent casualties. As a consequence, he suggests another moral judgment that Nobel should have given up developing explosives and should have invented other things which could not harm people.

Junsu also wrote his critical reflection on Nobel's life as follows:

> When I thought how he became a scientist, it seems that his father's factory influenced him. Without his father, he wouldn't have become painful, disappointed, or discouraged this much. I think his father did a wrong thing. And if Nobel had lived a different life, he would have done all kinds of things with his intelligent brain. If I was born with his good brain, it would be really good for me. There is something strange for him. I wonder why he invented weapons. I don't know why he felt pain while he continued to invent weapons. I evaluate Nobel in such a way that he just did one good thing for peace. I think any person actually can do one thing for peace. Therefore, it seems that Nobel is not a special person but a same kind of person just like us. Indeed, it is not an easy thing to donate all his fortune, but I think mind is more important than money is. (Children's Writing, 12/29/2003)

At a glance, Junsu's reflection seems more critical of Nobel's life than Sungju's. However, Junsu tries to see Nobel more as a normal person who can make mistakes anytime while Sungju tries to judge Nobel more as a whole moral scientist. First, Junsu attributes Nobel's moral struggles to his existential conditions such as his father and his father's factory which were full of scientific instruments which stimulated Nobel's lifelong pursuit of becoming an inventor. Junsu expresses sympathy for Nobel by writing, "Nobel would have lived better, if he lived a different life." He also points out Nobel's discrepancy in such as way that Nobel's actions are contradictory to his conscientious voices. He values Nobel's donation of all his fortune but reaches a conclusion that Nobel is no more than a common person just like him. He provides two reasons for his moral viewpoint. The first is that any person can do one thing for world peace. The second is that mind is more important than money is. I presume that Junsu has gained a deeper understanding on the moral experiences of Nobel as a scientist and technologist by seeing Nobel as a common person who is struggling with his internal and existential conditions.

As we have seen in the above four examples, children's reflections on Nobel were all different. Some see Nobel's life more in positive ways while others see his life more in negative ways. Some felt Nobel's life more personally while others felt his life as a more social matter. Some interpreted Nobel's life more as a common person while others interpreted his life more as a scientist and technologist. The differences in their reflections are rooted in children's unique personality, ability, interest, prior knowledge, and social setting. However, it is also true that each of the four children has formed their own reasonable standpoints on Nobel's life. Meyer (1994) pointed out that the ability to empathize with others and imaginatively construct their unique viewpoints is critical to moral insight and wise moral choice, but ethics that base moral judgment on a universal conception of the individual marginalize this skill. Jinju and I tried our best to have children actively and freely discover, respect, care for, and dialogue with their own personalities, abilities, interests, and social settings by positioning children in Nobel's life and repositioning them in their lives with moral insights. Children will probably change their moral viewpoints on Nobel through other interactions with people and spaces they encounter. However, it is true that their reasonable moral viewpoints on Nobel they made in this study came from their own ability, and they, as moral capacities, will be another footstep of constructing their existential moral world.

Self-Reflective Practices

We also found the evidence of self-reflective practices from some children while we were engaging in Nobel's biography. Brown (1997) explained that reflective activities such as constructive discussion, questioning, querying, and criticism, in time, become internalized as self-reflective practices. Sangsu and Bin showed how their self-reflective practices influenced the way they saw Nobel's life between their reflective practices with Nobel's biography and with STS practice journal. Children frequently addressed their difficulties of using technology in their daily lives while working on STS practice journal. All children except Chosun told us that taking action is really hard for them. While working with STS practice journal, Sangsu also made an effort to use the technologies in his daily life too. But as many others did, his efforts frequently were in vain. By constant self-reflective practices of comparing his life struggle of practicing positive use technology with Nobel's struggle of overcoming STS moral issues, Sangsu came to respect Nobel for his whole life contribution to making his dream come true by overcoming all the difficulties. This is the reason Bin continuously reflected on Nobel's life while working with her STS practice journal. Bin said:

> While listening to Nobel's story, my feelings have changed continuously. Sometimes, I felt he was a great person. Sometimes, he looked like a bad person. Sometimes, he looked like an idiot. But, now, I think he is a great hero because he overcame all difficulties and donated all his money for world peace. I've come to know that taking actions are really hard by doing my STS practice journal. And I think Nobel is great because he overcame all the difficulties. (STS Issues Meeting, 12/17/2003)

Like Sangsu and Bin, all children tried to use technologies better in their daily lives one way and another, but their efforts considerably were in vain. (See Appendix 8 for the comparison of children's self-evaluation for their efforts and their success after the study). By feeling that practicing was harder than they expected, they went through a conscious process of knowing who they are, who they were, and who they will be in terms of using technologies.

STS Practice Journal (11/28-12/27)

Introduction

Based on Dewey's (1938) "experiential continuum," the purpose of STS practice journal was to provide children with a reflective space in which they could 1) make sense of their practices of using technologies, 2) make moral decisions on how to use their technologies, 3) take actions based on their moral decision making, 4) reflect on the results they make, 5) and lead to more meaningful experiences of using technologies.

The idea of STS practice journal came from Jinju. Before engaging this activity, we were encouraging children's practices of using technology both through STS issues meetings and through Jinju's feedback on their STS journals. But Jinju met such a challenging concern in the middle of her teaching that children's practices of using technology remained almost the same. When she asked her students whether they had made any changes, she was easily frustrated with their negative responses. For example, some children continued to enjoy violent computer games and go to PC rooms filled with smoke. One day, Jinju happened to check the writings her children put on their class website and read Eunhee's story about an old lady. Jinju told her reflection on Eunhee's story and addressed her concern at our regular meeting:

> You and I have emphasized children's taking right moral actions. But children haven't made many changes. I mean in terms of their action. I think we should work on this issue more systematically. I saw Eunhee's writing on our class website. Eunhee was once walking on a road and saw an old lady carrying heavy baggage. She [Eunhee] said she carried the heavy baggage to the old lady's house. I couldn't do that kind of nice things even if I were in that situation. I felt her decent behaviour was so beautiful. (11/22/2003)

Jinju continued to reflect on this incident and related it to the stagnant conditions of children's moral actions in practicing good use of technology. Although this incident was not related to the use of technology, this reflection enabled her to know how much important it is to educate children to lead to right moral actions. At the meeting, she recommended to use a kind of small practice journal for the children. I was really moved by her deep contribution at the moment. After a few days of intensive discussion, children made their own STS practice journals on November 26, 2003. I, hereafter, show how Sora worked on this activity until the end.

Sora was the child who spent time on this study the most among all students. She wrote 132 page long STS journal,[17] read twenty seven science books, and made a great many efforts to change her use of technology. She lived with her parents and an elder sister. Her father was a taxi driver, and her mother had worked in a beauty shop as a hair designer until she finally opened her own beauty shop at the last part of this study. Sora really liked this study and wrote two personal thank you letters to Jinju and four personal thank you letters to me during the study. Nevertheless, she was quite puzzled with my presence at the beginning. She wrote her feelings to me as follows:

> Hello Teachers:
>
> … Teacher! I was really surprised. There are so many wonders in this world. Teacher! Don't make fun of me. I didn't like science and the conversation about science. When you entered my class, I felt so unpleased and thought "what is the use of learning science and technology?' But I now regret why I thought that way. Now I've come to like the lessons my teacher taught for us more than any subjects. Wouldn't it be possible for you to teach more lessons? [I did not teach, but she knew that I was the original source of this study.] My mom says that I've got interested in science more than before. And my mom and I have come to know many new things. There are many science books in my home. What should I do, if I spend all the science books? [Her worry is that she may not have any more topics for keeping her STS journal when she used up all the topics in the science books at home.] I wish you also will lead the

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[17] STS journal and STS practice journal are different. STS journal is children's personal journal by which children keep their diaries on STS issues they face in daily life. STS practice journal is a small journal by which they set goals of using their technologies and write the stories of their practices while practicing STS practices.

> lessons interestingly. Thank you for teaching these lessons for us. (Personal Letter, 10/7/2003)

From the beginning to the end of this study, Sora actively addressed her issues of using technology in class, in STS journal, and at STS issues meeting too. Nevertheless, I narrate her stories based on her STS practice journal writing, one or two stories per week.

First Week

On the second page of her STS practice journal, she wrote her resolution as follows:

> My Resolution
>
> I will think about how to use science and technology in right ways.
> I will write honestly.
> I will make efforts to use science and technology in right ways.
> I will reflect on what I will have not done well and take an action again.

Every child wrote their resolutions and worked on this endeavour on a weekly basis. In terms of writing process, all children, first, recorded their practice table on the third page; recording goal practice contents they decided to work on, evaluating their practices on a daily basis in the morning, and receiving their homeroom teacher's signature on a weekly basis. Fourth, they wrote their stories from the fourth pages on. Jinju wrote encouragement feedback on their STS practice journal. Jinju also showed some of the good stories they had written to the whole class to encourage and guide their efforts. The following is the results of Sora's practice table:

Table 5.

Results of Sora's Practice Table in STS Practice Journal

Period	Goal Practice Contents	Days							Teacher Sign
		1	2	3	4	5	6	7	
Week 1	Do not use bad language	○*	○	○	○	○	X	X	
11.30	Do not open sex sites	○	○	○	○	○	○	○	
-									
12.06									
Week 2	Play in a safe place	○	○	○	○	○	○	○	
12.07	Do recycling	○	○	○	○	○	○	○	
-	Reduce computer time	○	○	○	○	○	○	○	
12.13	Do not use ready-to-use items	X	○	○	X	○	○	X	
Week 3	Save water	○	○	○	○	○	○	○	
12.14	Have a balanced diet	○	X	○	X	○	○	X	
-	Pick up garbage	○	○	○	X	○	X	○	
12.20	Do not eat sub-quality food	○	X	○	○	X	○	○	
	Garbage classification	○	○	X	○	X	X	○	
Week 4	Do not use bad language	X	○	○	○	○	○	○	
12.21	Do not go to a PC room	○	○	○	○	○	○	○	
-	Do not use ready-to-use item	X	○	○	X	○	○	○	
12.27									

Note: * indicates that by ○, Sora did well, and by X, Sora did not do well on that day.

During the first week, Sora set two goals: 'Do not use bad languages' and 'Do not open sex sites.' Not using bad languages was the most popular goal practice content of their STS practice journal among the children. Using bad language was recognized as part of misusing technology because some female children said they learned bad languages from internet fictions, chatting, and movies during a class (Regular Meeting, 11/22/2003). Internet fictions written by adolescents or university students are popular among the children in Jinju's class. I looked over six internet fictions Sunmi brought for me, and the characters in those fictions constantly use bad languages. Using bad languages is often described as the symbol of coolness, toughness, and close friendship in those fictions. Besides, there have been several popular Korean movies among elementary children in Korea in which young gangsters who are treated as bad students in school frequently use bad languages as a resistant culture of the adolescents who have failed in adjusting to the oppressive school cultures. Sora was not an exception. Sora said she was often using bad languages and she had difficulty in not using bad languages at our STS issues meeting (11/28/2003). During this week, Sora used bad languages two days: One, with her elder sister and the other, with her friend. On her STS practice journal. Sora expressed her feelings as follows:

> I feel sorry for my friend and my elder sister. But I couldn't say I am sorry at the moment because I've already used bad languages to them. I made my resolution that I wouldn't use bad languages [again], but I was not sure whether I could not do it. I think that's why we must make a lot of efforts. (STS practice journal, 12/8/2003)

As she wrote, it was very difficult not to use bad languages because Sora already had a habit of using bad languages when she got angry. She learned that her strong decision-making did not necessarily lead to the proper action she had planned because of her indurate habit. She also learned that correcting wrong habits requires rather long-standing efforts.

Second Week

During the second week, Sora worked on four goal practice contents: 'Do recycling,' 'Do not use ready-to-use items,' 'Play in a safe place,' and 'Reduce computer time.' In terms of 'Do recycling' Sora worked on three items: the scrolls of toilet paper, separate garbage disposal, and hair dye pack. For the scrolls of toilet paper, she wrote as follows:

> Science in our daily lives !!!
>
> When we look into things in our daily life, we can recycle almost all things!!!
>
> A few days ago, I saw the scrolls of the toilet paper used up. I thought they seemed to be reused somehow, and I made a doll with them. I made only one, but what I learned from it is a few times more than that. Even if those seem useless pieces of paper, they

> can become precious things… It seems very precious and important to see the existence of science in our daily life. (STS Practice Journal, 12/15/2003)

Sora also practiced throwing garbage in separate garbage cans. Because of Korea's population density, garbage problems are becoming more serious issues in Korea. Koreans have to observe separate garbage collection regulation and use paid garbage bags when they throw away garbage. Sora had been usually careless of her practices of throwing garbage before she practiced it through this activity. She said it was quite hard to sort out every piece of garbage into cans, food, glasses, plastic, and ordinary garbage. It must be hard because she not only had to prepare many bags for different garbage but also had to be always attentive all day long. However, she said she did not feel her practice as a burden at all simply because she had a mind of her dedication to Korea's clean environment.

When Sora was in her mother's beauty shop, her mother gave Sora a pack of hair dye left after using it for a customer's hair. Her mother recommended Sora to use the leftover for her hair. Suddenly, a good idea came upon Sora when another female customer came in to have her hair dyed after about an hour. Sora asked her mother to allow her to dye the customer's hair with the leftover. When her mother said it was not allowed to use the leftover for our customers, Sora told both her mother and the customer that she would wish to reuse it to preserve her country's environment. The customer was impressed with Sora's intention and allowed Sora to reuse it for her. Sora dyed the customer and the customer expressed her full satisfaction with the way her hair was done—Sora sometimes helped dying her mother's customers for fun. She received praises both from the customer and from her mother for her recycling. However, she humbly yielded all the praises to her mother. She wrote her reflection as follows:

> My mom gave me praises for my recycling the hair pack and for my spirit of frugality. But I am more proud of my mom, not me because she practices recycling. If we pay a little more attention to the spirit of frugality, we can protect our nature. (STS Practice Journal, 12/15/2003)

I found where Sora learned from her practices of recycling later on her STS journal:

> Throwing all the garbage in her beauty shop is a really hard work to my mom. But in the middle of her busy work, my mom always practices separate garbage disposal. She did not make even a single mistake. It felt strange. I thought to myself, 'How can she throw all the garbage separately without any mistake in the middle of such a busy work. I couldn't understand my mom. When can I finally learn from my mom? In my thought, it will take so much time to learn. I will continue to do my best to learn from my mom. (STS Journal, 12/15/2003)

For 'Do not use ready-to-use items,' Sora worked on two items: paper cups and one time use chopsticks. There was a water purifier in her mother's beauty shop. Almost all the customers used to use one or more paper cups to drink water or coffee while they were in the beauty shop. Sora was also frequently using the paper cups. But while working with her STS practice journal, Sora made sense that using too many paper cups would do harm Korea's nature. She thought over how the use of paper cups could be reduced, but she could not find any better ideas. She asked her mother to sit together and discuss this issue. Her mother welcomed her suggestion, and they pondered over the issue for a while. They reached a conclusion that paper cups must be used for the health of all the customers. However, they also reached an agreement that they would use regular cups for themselves instead of using paper cups. After this agreement, Sora was in charge of cleaning their regular cups. A day later, she also found that they were frequently using one time use chopsticks. So, they reached another agreement that they would use regular chopsticks for themselves too. Again, Sora became responsible for cleaning the regular chopsticks for themselves.

Sora wrote her reflections on her practices during the two weeks as follows:

> I didn't practice much. Especially, I continue to buy and eat sub-quality food. So I think I should try more efforts. I will think about the importance of action and make efforts to lead to proper action. And I've also listened to what other friends did, and they did better than I did. I will do better than my friends.
>
> Things I did well and my next plan:
>
> I wrote honestly and I feel good and proud of myself because I have made many efforts. Besides, I've come to know what I did wrong, what my habit is, and what difficulties I have. From now on… I think I should live on a regular basis and reduce my habit of buying sub-quality food. And I will pick up garbage well with my friends in parks and in playground. I will make an action by all means. (STS practice journal, 12/15/2003)

Third Week

During the third week, Sora worked on 'Pick up garbage,' 'Have a balanced diet,' 'Save water,' 'Do not eat sub-quality food,' and 'Garbage classification.' The first two items were the main jobs she mostly contributed to. It was when she passed by the small park where old males were spending their day time. As Bomi noticed, Sora found a lot of garbage dropped on the ground around a garbage can. The garbage was mostly thrown by the old males who continued to eat food by ordering meals from nearby restaurants by using cell phone. On December 15, Sora saw the garbage overflowing from the garbage can again when she was passing by the park to go home. But this time, she took up courage and approached the garbage can. She pressed the garbage and picked up garbage scattered around the park. She said the old people looked ashamed of themselves. She practiced her practice of picking up garbage until the end of this study. Besides, she frequently did pick up garbage in her classroom too.

Having a balanced diet is another topic she worked on intensively. Sora's mother always cooked balanced food in the morning for her family before she went to her beauty shop where she had to work until 10 o'clock at night. However, Sora did not like vegetables and fish, particularly anchovies, and frequently avoided eating these kinds of food. It was in our STS issues meeting (12/9/2003) that she made her resolution to eat those kinds of food, especially because Bin told her stories of becoming successful in eating a balanced diet. While Bin worked on this topic more to care for her own health, Sora worked on this topic in a different way. Sora did not like her practices of throwing the food garbage left by not eating vegetables and fish particularly because she thought that her bad practices would add harm to Korea's environment. Like Bin, Sora had to struggle with eating those kinds of food at the beginning, but, later, her practices of having a balanced diet was improving more and more. It was after three weeks of her practices at STS issues meeting (12/20/2003) that she said she came to like those kinds of food after all. At the end of this study, Sora reflected on her practices on having a balanced diet once again. She wrote.

> I did not eat all the good food that week. But those kinds of food are very nutritious food which has natural vitamin, protein, and other good nutrition. I still regret that I did not eat and threw them into a food garbage bag. (STS Practice Journal, 12/26/2003)

Jinju gave a big praise to Sora for her efforts and success she made. Jinju was also happy that she could find less food leftover after lunch time, even if she did not ask the children to eat all their food.

However, she was not quite successful in not buying sub-quality food sold at illegal wheeled snack bars with a tent. Sora wrote her reflection after third week in her STS practice journal as follows:

> This week I couldn't reach my life goals fully in terms of recycling, balanced diet, and stopping from sub-quality food. I don't know why I couldn't practice very well. I didn't do better this week, but I will try to be better. I will also think more about why I

> didn't do much and try more in a later time. I cannot promise, but I will continue to practice. Probably it will help me to grow.
>
> Expectation
>
> Next week I set these goals: I won't go to PC room. [PC room is a computer room where you can play games. Children are exposed to adults' smoking and they can both log on immoral websites and see adults' use of violent games.] I won't use bad words. I won't use ready-to-use living items. I think not going to PC room is probably the easiest. And not using bad words will be the toughest of all. I am not sure how I will do with 'not using ready-to-use living items.' (STS practice journal, 12/22/2003)

Fourth Week

In the above narrative, Sora predicted that not going to PC room would be the easiest one. But the reality turned out to be so different that she had to make a tough moral decision-making during this week. She wrote her reflection as follows:

> On Christmas, I played with my friends at school and all of us came to my mom's beauty shop. Then, my elder sister suggested that we should go to PC room. But I remember what I wrote in my practice card 'I won't go to PC room.' So only my elder sister went to PC room and I didn't. So, I put up with it so well, and I am proud of myself. I will not go next time either and I will also take the mind of wishing to go there away from my heart. After having returned from a PC room, my elder sister told me "I would be suffocated to death because of the smoking [in the PC room]." I thought to myself that 'I made a right choice.' I wish my elder sister won't go there next time. (STS practice journal, 12/26/2003)

At the end of this study, Sora reflected on her practices of technologies on her STS practice journal as follows:

> My final reflection
>
> Writing on my practice card taught me how much I have used science and technology wrongly and how I have lived with them in my everyday life. By using this, I've come to know what things I'm struggling with the most and it allowed me to reflect on those things and have led me to practice. And it also allowed me to make efforts to practice what I wrote, and to think about the ways of solving the struggles. And now, I feel meaningful and fruitful by practicing those ways. I feel good because I corrected my bad practices of using science and technology in many ways and I have been living rightly through reflection in my daily life. (STS practice journal, 12/27/2003)

Sora's Existential Conditions of Technology

There are, on the one hand, many aspects of technology affecting Sora's life as her powerful existential conditions. On the other hand, every movement she was making in her life was her existential effort to cope with her existential conditions of technology. The following story is about Sora's existential struggle with her existential conditions. I took Sora to her mother's beauty shop on December, 23, 2003 to explore how Sora found her meanings of life in her mother's beauty shop partly because Sora talked many times about her mother and her mother's beauty shop at STS issues meetings and partly because I became so interested in her mother's educational practices with her two daughters. On the same day, Sora made a Christmas tree in her art class in school and brought it to her mother's beauty shop while other children left theirs in their classroom.

Sora's mother worked as a hair designer for five years, and she opened her own beauty shop on December, 1 in 2003, 22 days before my visit on that day. Sora usually went to her mother's beauty shop right after her study at a private institute by using the private institute bus. In the beauty shop, Sora studied, watched TV, and read books. Besides, Sora almost always volunteered to help her mother by cleaning the floor, and she sometimes set dinner for her mother and herself when her mother was extremely busy. Sora stayed in the beauty shop for about five to six hours a day and returned back home with her mother after her mother closed her shop at about 10 p. m. Sora was especially happy those days because her mother got her driver's license and bought a small car several days before my visit, which provided an easy transportation to her way home. Sora said her mother was a novice driver, but she was happy because she did not have to wait for buses any more (Interview, 12/20/2003).

Even if Sora mentioned how meaningful her mother's beauty shop was to her, the shop could not be her best place at all. Sora talked about this on December, 20, 2003, on my observation day for Sora. Her mother's beauty shop was more a place of negotiation to cope with her life. I asked, "Which is more comfortable between your house and your mother's beauty shop?" Sora responded as follows:

> My house is more comfortable. I can sleep there [in her mother's beauty shop]. But there are lots of cars passing by. That building has three stories, and so there are many children [and babies] making a lot of noises [in the building]. You know babies sleep late. (Interview, 12/20/2003)

Sora's room in her home was filled with good technologies such as nice bed, piano, and a computer. But she could not find herself comfortable at home any more because her elder sister came home at midnight after her study at her private institute. Her elder sister was only 8th grader, but she was busy with her learning from the morning till midnight. She said she would stay at home if her elder sister stayed at home. Her father also was not able to stay at home until midnight because he had to work outside until midnight. So, Sora and her mother usually stayed in her mother's beauty shop after school while Sora's elder sister and her father ate dinner together at home and worked in different places: one in a private institute and the other in a taxi. Sora and her mother came home about 10: 30 p.m. When Sora's father came home after picking up his elder daughter at her private institute at midnight, all the busy daily life of Sora's family finally ended.

Sora's best place is her school. She liked being with her teacher and friends particularly in art class, lunch time, and school trips. She especially liked the ways Jinju and her former fourth grade teacher cared for her children and she said she was dreaming to be a homeroom teacher like Jinju and her former fourth grade teacher. When I asked why she liked them, Sora led a discussion as follows:

> *Sora:* I like my teacher because she plays with us much.
>
> *Researcher:* Most of the teachers have good memories about their teachers in their young ages. Do you have such kinds of memories too?
>
> *Sora:* Yes, My fourth grade teacher often comes to my class. Once, he visited our class while my teacher [Jinju] was away for something. He told us good stories. When we fought each other by using bad languages to each other, he told us that why using bad language is bad and he guided us to the right ways. [Sora is talking about her fourth grade experience.] Once there was a student who used a bad curse. So, my [fourth grade] teacher asked us all to write all the bad languages we knew on our notebooks. We wrote all the bad words we knew. And my teacher asked us to underline the bad words which we happened to have used even if it was just once in our life. He said if we would continue to use them, he was going to spank us next time even if he would hate to do it. We did not get spanking from him, but we had to be grounded in the building during the lunch time for three days. At the time, we all used bad languages for him [after being grounded]. But I rethought about it a few times recently and came to know that he did it in order to correct our bad habits. I think he made that kind of strong mind even if it was hurtful for him to punish his students. So, I thank him so much. (Interview, 12/20/2003)

In the above narrative, Sora sees her former teacher's harsh reproach and punishment as part of caring. Sora believes that it is desirable for teachers to take actions to correct the serious misbehaviours of their students even by using physical punishment. It seemed that Sora respected him because he taught her what was right and wrong and helped them to grow in right ways. Our talk reminded me that it is not desirable to teach values in forceful ways in school, but it is even worse to remain as a mere spectator for the misbehaving children.

Her English institute is another place of meaning in her life. She once learned different subjects at other different institutes. But she quit all the learning, and she was only learning English at her English institute at that time. Sora was a hardworking student in school. This was the reason her mother recommended Sora to concentrate on studying English only after school. Sora was happy to be in her class in the English institute talking to her Canadian English teachers. Sora told me how much fun her English study was as follows:

> *Researcher:* What is it like studying English with foreign English teachers?
>
> *Sora:* (Looking very interested), they make fun. They can't speak Korean well… They can't understand what we are saying. When they tell, 'be quiet [in English],' we say, 'Be quiet [in Korean]. Then, all people make a big laugh.
>
> *Researcher:* Did you understand at the beginning?
>
> *Sora:* I felt so shy at the beginning. But now I like being with foreign teachers the most. (Interview, 12/20/2003)

By learning at English institute, she said, she is having another future dream of becoming a simultaneous interpreter. Once she saw an interpreter translating English into Korean simultaneously and she felt impressed with the interpreter's capability. She said she would wish to study English as hard as she could to be a fluent English speaker. Indeed, Sora was not a mere student who was only affected by her existential conditions of technology but an active meaning maker who was reconstructing her existential conditions of technology to lead a more meaningful growth of her life.

As shown above, Sora's parents and her elder sister were all busy in their worksites, and, thus, Sora's existential conditions did not seem to be better than any other friends'. However, Sora and her elder sister were both good and decent students to all of the people around them. Jinju even thought that Sora's mother must be at home and busy with spending her time for Sora because of Sora's decency. But the reality was quite different from her guess. Then, how could Sora's existential conditions of technology worked nicely for Sora? The secret was uncovered by my interview with Sora's mother, Gukhwa.

Sora's Moral Capacity and Her Mother's Caring

When I arrived at Gukhwa's beauty shop with Sora on December 23 2003, Gukhwa welcomed my visit and offered a cup of coffee, of course. I used a paper cup because I was neither Sora nor her mother. It was nice to see Gukhwa drink her coffee with a regular cup. We made a big laugh when we talked about their practices of using a regular cup because of Sora's efforts of recycling. Luckily, there were not any customers in that evening, which made our interview possible. I started my talk by greeting, "Sora really did contribute to our science and technology to a great extent." Gukhwa responded by saying, "Sora seems to have done too excessively [for this study]. But it is OK because her devotion comes from her own desire" (Conversation, 12/23/2003). Gukhwa told her stories for about three hours. Personally, this interview is the moment I've listened to a person's story the most active way for my whole life. I know this because I spoke only a few words during the whole interview.

Gukhwa was raised as the eldest in a poor family. Her parents wanted her to go to a commercial high school so that she could find a job after graduating from her high school and assist the education of her younger brothers financially. She really wanted to go to a university, but she could not simply because she was a woman. Gukhwa said she once had a great resentment against her parents because she studied very well in her commercial high school too. That was the reason she was still having a lingering affection for her learning. She had been a housewife for about ten years before she started to learn beauty art at her age of 35. She said she could not enter a university after marriage because she had to take the competitive university entrance exam the name of which itself already sounded unfamiliar to her. Beauty art was the negotiation by which she could pursue her professional career, her housewife responsibility, and the financial solution for the pressing private education for the two daughters. After five years of hard work, she finally opened her own beauty shop, and she was planning to study beauty art at a university near her home. She said she could be accepted as a special student because she had a beauty artist certificate. If possible, her final professional goal was to teach beauty art to university students. She became so happy by imagining that her daughters and she would go to university together some time.

Gukhwa has some clear educational philosophy in nurturing her daughters. Gukhwa's first educational philosophy is 'becoming a good model of living one's own life.' She said:

> Sons and daughters seem to learn by seeing how their parents live. An example might be when they feel 'Our parents live their own lives well.' You know I haven't spent much time for my daughters, but they live up to my expectations as decent girls… I remember the time I was hurt when Sora said, 'Mom, would you come to see me in the play I do today [in my school] because all parents are invited.' I couldn't see my daughter's play simply because I had to work. So, I said, 'I am really sorry, my daughter,' and I explained the reason. She must have been disappointed but said to me, 'I understand you.' But as they grow older, they respect me more than before. I opened my own beauty salon just about 3 weeks ago and, a few days ago, Sora said she wants to live just like I live. So, I think parents should live their own lives well. Then, their children will respect their parents as they grow older even though they did not before. (Interview, 12/23/2003)

Children learn more by seeing how parents do than by listening to what parents say. As children see their parents create their own meaningful storied lives, children naturally become aware of how a life should be lived meaningfully. I saw many parents devoting their whole life to their sons and daughters in order to see them excelling others in every aspect of school life such as academic achievements and school competitions. I saw some mothers abusing their sons and daughters mentally and verbally when their children could not catch up with their expectations. Some of them even lobbied other students to select their sons and daughters as the class leader in class[18]. They seem to find their life meanings in their sons and daughters' excellence over others, not their own. As Gukhwa pointed out, I saw many clashes between these parents and their sons and daughters as they grew older and I often became a mediator between their struggles. I know that these parents love their children, but they seem to see their children mainly from their egoistic mode of having.

Gukhwa's second philosophy is 'becoming an active listener.' She said, "I am very busy, but I spend lots of time talking to my daughters. After hearing their wants and wishes, I then judge what I should do." (Interview, 12/23/2003) Gukhwa is a very active listener and dialoguer for her daughters. In her beauty shop, she constantly asked and listened to Sora's life in school and provided encouragements and helpful guidance for Sora (Observation, 12/23/2003). I felt that Gukhwa tried to listen to Sora not because she needed to control them but because she wanted to understand Sora's life to help her to cope with her life better.

Gukhwa's third philosophy is 'growing a person as an independent being.' She said:

> Parents, when bad things happen, may die. This might happen to them [children] you know. Even if this happen to them, they should live as independent persons. They might be sad and might be in a difficult situation. But they have to overcome by thinking that there are many good things to live by and they should have capacity to live happily in this world. Others cannot help them permanently. (Interview, 12/23/2003)

Gukhwa believed that it is important to educate children to have capacities to live their lives on their own. She mentioned several times that parents may be gone away any time. Her concern seems natural partly because there are a growing number of parents, particularly, fathers who pass away from chronic stress and fatigue, traffic accidents, and cancers and partly because there is also a growing number of divorce rate which ranks Korea as one of the highest in the world. Gukhwa believed that her daughters have their own lives to be respected and, thus, her responsibility was to assist them to have capacity to live happily with courage and hope for their lives so that they could overcome the harshest moments in their lives.

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[18] In Korea, there is a class leader who is the representative of all the children in the classroom. What a class leader usually does is to help their homeroom teacher. She or he sometimes helps controlling their class.

Gukhwa's fourth educational philosophy is 'being responsible carer for children.' She gave an example as follows:

> Children sometimes make mistakes or faults, but they always have room to be on the right track because children are genuine and flexible. My eldest daughter once had a close friend. Her friend suddenly started smoking and got along with some bad guys at some point. My daughter came to me and said she would stop talking to the friend. So I said 'Don't judge a person out of only one reason.' Children can do that kind of bad thing sometimes because of curiosity and sometimes because of bad family environment. I recommended my daughter to tell her friend that 'It [smoking] is a bad habit and please quit it.' However, she couldn't say it to her friend. My daughter said that she simply couldn't. She said, 'I don't want to talk to her any more.' So, I said again, 'Then, why don't you go to your homeroom teacher and tell him that you have your close friend starting smoking and going along with some bad friends. I said, 'you can ask you teacher to guide your friend to be on the right track' I also said 'you can ask him not to reprimand your friend too much because your friend might not like you.' You know children's bad behaviours can be corrected easily, but adults cannot change their bad behaviours easily. So, it is always good to correct them as early as possible. (Interview, 12/23/2003)

I felt a deep insight from her narrative because Gukhwa was not only a carer model for her daughters but also a sincere carer for other children. When her elder daughter did not want to talk to her close friend who started smoking, she taught her not to judge a person in simply ways and asked her to be a good carer for her friend. I once saw a group of children frequently smoking and yelling in front of our university SUB, when I was studying in the United States. However, nobody seemed to care about what they were doing even if they did for a whole year at the spot. One thing for sure was that they needed someone to care for their internal and existential conditions. From my 10 years of experience as an elementary teacher, I also agree on what Gukhwa said. No matter how difficult our situations are, children need to know what is right and wrong, and their misbehaviours must be corrected as early as possible before they become indurate habit. Sora also talked about a similar opinion to her mother when she talked about her fourth grade teacher.

On my way home on highway, I continued to reflect upon what Gukhwa told me. What is care? How do we need to care for our children? What is becoming a responsible carer? I think being a teacher is a very professional job because we teach the children of others just like we do with our own children at home. Everyone cannot do this without sincere caring spirit and this is why, I believe, being a teacher is a very professional job. By listening to her story of stopping children's fighting and teaching why they should not fight, I saw her responsible caring spirit from which we, educators, should learn. Gukhwa also taught me how to raise children to be good carers. Gukhwa has taken her daughters to their grandparents' homes since they were very young. Her family oftentimes goes to her relatives and phones them. Even if Gukhwa's parents forced her not to go to a university, Gukhwa said she was respecting and caring for her parents. Indeed, her daughters learn by seeing what Gukhwa does, not by listening to what she does.

As I said earlier, Sora's existential conditions were not better than anyone else in her class. Many of her technological conditions work as negative forces particularly because of her family members' busy work. But Sora had capacity to change her harsh technological conditions into a creating force. As we see, her capacity was fundamentally raised by her mother's sincere caring: becoming a good model of living one's life, becoming an active listener, growing a person as an independent being, and becoming responsible carers of children. This was the reason Sora frequently talked about her mother and her mother's beauty shop even if working in that space was a struggle of her negotiation between her internal conditions and her existential conditions of technology. Without her mother's sincere caring, her mother's beauty shop might become a meaningless place where she only finds noise, dirty hair, no food, no computer, and, thus, no meaning. Almost all of Sora's existential conditions such as people, things (visible or invisible), places, and interactions were all shaped by powerful science and technology. Sora, however, actively created her life meanings in her existential conditions of technology. Learning English, art materials, school trips, riding inline skates with friends, and reading books are part of her interactions by which she was shaping her existential conditions of technology more desirably. Indeed, her capacity to cope with her existential conditions of technology came from her mother's sincere caring.

Sora wrote her final reflection after finishing this study in her STS practice journal as follows:

> Through science and technology lessons, there are many things I've thought about. Why do scientists not give up? Why do they invent bad things and lead people to be killed… [She is talking about Nobel.] I thought this way and that way… I thought much, and it enabled me to have the power to think. By thinking many things, I've come to relearn all of what I've learned. By thinking so much, I also continue to remember what I learned well. (STS practice journal, 12/29/2003)

Sora's final reflection reminded me of Friere (1971, p.76)'s words "reflection takes on meaning when it leads to action—the praxis of reflection and action." Sora's reflections sometimes led to action, but her reflection sometimes did not. But I know that all of her reflections while struggling with practicing her good use of technology took meanings in her life struggle with coping with her existential conditions of technology even if she was not successful in practicing all of her practice contents. As Friere (1971, pp. 77-81) pointed out, Sora's journey in a reflective space of working with STS reflective activities was accompanied with 1) her 'profound love for the world and for the human beings' through her emotional reflections on Sadako Sasaki's life, 2) 'humility' through her aesthetic reflections on her lack of capacity to practice recycling by comparing hers with her mother's practices of recycling. 3) 'an intense faith in her power to make and remake' by her volitional reflection on changing her bad habit of using technologies, and 4) 'hope which is rooted in human beings' incompletion' through her intellectual reflection on her constant trial and error of becoming a responsible citizen of using technology.

Sora put her Christmas tree she had made in art class beside the big mirror in her mother's beauty shop, and she positioned and repositioned the Christmas tree while her mother and I were having an interview. Her body movement with a little technology, Christmas tree[19], was just another piece of her effort to create her better existential conditions of technology. Indeed, from Sora's experience, I confirmed that the responsibility laid before me as an STS educator is to provide a caring reflective space in which children grow and strengthen their moral capacity to make sense of their internal conditions and existential conditions of technology, make moral decisions, take actions, and lead a meaningful storied life with their existential conditions of technology.

STS Jounal (9/22-12/26)

The purpose of this activity was to provide children with a reflective space in which they could make sense of their existential conditions of science and technology and make sense of who they are and what they should do with those conditions.

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[19] Christmas tree is part of technology because without the technological development, students could not make the Christmas tree in easy ways in school such as carbon, coloured, and cello-phane paper, cotton, and glue.

Curriculum Design

Journals allow a safe, pressure free space and time to explore children's feelings, ideas, and thoughts, which encourages them to reflect on the STS moral issues in their surroundings. Interactions between children's internal conditions and their existential conditions are critical in growing and strengthening children's reflective capacity to create their meanings in relation to STS issues. Thus, journal writing plays a bridging role of connecting what they learned in school to their moral construction. In this study, each child's STS journal was turned in to Jinju and returned to the child with her feedback and encouragement. At the beginning, children usually cut and pasted pictures of STS related news from newspapers or web pages out of the children's interests and wrote their reflections on the issues. As time passed, however, children naturally wrote their reflections on their everyday life STS issues more and more. We encouraged children to jot down any STS issues they would encounter in their daily life and reflect on the issues more, and write at home. They also used their STS reflective journals for conversation and discussion in class. Jinju's feedback was only used to encourage their reflective practices and she tried our best to be neutral in her value judgment in STS journal.

We provided children with a list of recommended children's website newspapers and other helpful website resources and for their easy use of information. Children's newspapers have a couple of advantages. First, it provides a wide variety of practical STS issues of present times in relation to politics, international relations, economics, personal stories, medical news, society, and culture. Second, they are easy to obtain. There are several web-based children's newspapers produced by major newspaper corporations in Korea.

Children wrote their STS journal from September 15, 2003 to December 26, 2004. They were asked to write twice a week. If they had done as scheduled, they must have done 30 reflective stories. The majority of them did on a regular basis, but there are some exceptions too. Three male children did not write much. Two of them said that they simply lost their journals in the middle of this study. The last student used to say that he did not write and would give it a try next time. I here only show Chosun's STS journal and narrate how she grew her moral selves by her STS journal writing:

Chosun's Moral Dilemma between Diplomat and Professor

Chosun was a mature and intelligent child whose dream was to become a diplomat. Chosun's growth was quite different from other children in that she showed a great reflective capacity to make sense of social issues both in and beyond her daily life. Chosun was one of the few children who was originally aware of some negative aspects of science and technology before she engaged in this study (Pre-Study Questionnaire, 9/6/2003). She also wrote her own sensitivity to the negative aspects of science and technology at the beginning of this study as follows:

> In a word, I think even if science helps us to be more and more comfortable, it also can be used wrongly or unnecessarily. Science can be also used to harm our natural environment. I also think it is good for science to be improved, but it is not good for science to be used for harming others… (STS Journal, 9/23/2003)

Her sensitivity to the negative aspects of science and technology was far ahead of the other children most of whom made sense of the negative aspects of science and technology later in mid October through 'Interview with Parents.' However, Chosun took my presence in her class quite mistakenly as most of the other children did because she expected to learn something very scientific. She had continued to write her reflections on scientific wonders rather than societal wonders for the beginning two months, September and October. All of the examples were scientists, Icebergs in Arctic Ocean, human cloning, Mars, hidden secrets of fish, male and female, plants, aliens, sex transformation, and endangered plants in Korea.

However, it was right after listening to Sadako Sasaki's story on November, 10 that she wrote something personal or social in her daily life. She wrote her first societal views on STS issues as follows:

> War
>
> Are wars right things? I thought deeper whether they are needed for us. I think wars may be sometimes needed and sometimes aren't needed. When I think about the war between the United States and Iraq, it becomes true that United States did a wrong thing first. Iraq engages in a war for her revenge. However, there are many harms happened because of that. Therefore, we must avoid wars. If we engage in a war, we do wrong things. **The government [of a country] which started a war is not killed but it forces innocent people to pay for it by suffering their lives.** Besides, the country in which a war broke out falls into ruins, loses their cultural heritage, and needs a lot of time in recovering from it. Therefore, we must avoid wars. A war can be avoided, if each country controls their minds a little more. Each country must control their minds, by thinking that 'if our government causes a war because we are not satisfied with the other country, or because the other country is not obedient to us, we will be paid for it some time.' (STS Journal, 11/11/2003)

Chosun's narratives reminded me of Longino's two ways of value influences between scientific values (or technological values)[20] and social values. In the above narrative, Chosun more focuses on the impact of society on science and technology. Listening to Sadako Sasaki's story provided her a defining moment of her personal inquiry into the societal issues of STS phenomena. She learned that the problems of science and technology are more than an environmental issue and they are deeply rooted in people's everyday life. In her narrative above, Chosun said 'the government which started a war is not killed but it forces innocent people to pay for it by suffering their lives.' By this, she explains that engaging in a war is initiated by its government rather than people and, thus, relates the government of a country which starts a war to a kind of fundamental sources of war. She describes that the victims of a war are always innocent common people. Her ideas were the results of her reflection on Sadako Sasaki who was the innocent victim of the misleading Japanese government and Hiroshima Atomic Bomb during the Second World War. By saying that wars must be avoided and can be avoided by controlling people's minds, she looked into some values which could help us to avoid wars. She did not elaborate them, but those values match the humanistic values we tried to teach in this study such as human dignity, dialogue, respect, and caring.

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[20] I put technological values beside scientific values rather than social values only because the products of science and technology are closely related to each other.

As time went on, Chosun made sense of her existential conditions of technology in terms of personal and social issues. She writes:

> My changed life
>
> Before I learned science and technology [this study], when I saw people smoking, cars shooting out much gas, I just thought they were just bad and did not think that they harm our lives and world environment. But after learning this, I came to know that cigarettes and cars were all made from technology and scientific discovery. Now I have a habit of thinking how we use science and technology only in good ways. When I see a single desk, I think what kind of wood is used for the desk, how much resources are used up for the desk, and how its use affects our country and the world. And when I see TV, what we call, 'idiot box,' or when I see a violent cartoon, I came to analyze it and think deeper what is wrong with it. And I usually talk about the thoughts I felt each day to my mom and discuss those by giving opinions to each other. By doing this, my eyes became widely open to my mom's opinions and to the world and I came to achieve a variety of information too. By doing these, I become to have more talk time with my mom and think whatever around me. My mom once told me about a university entrance exam title given to a student that 'if your mom has a Parkinson's disease, do you want to leave her to a professional carer or do you want to care for her by yourself?" If that student couldn't continue to answer, the examiner tends to ask how she or he will do again and again. I think I should practice training my thinking skills hard because it will work better when I take a university entrance exam. Like this, I've come to have a right attitude of preparing for my future. (STS Journal, 11/17/2003)

As shown above, Chosun, this time, focuses Longino's first value influence between scientific values (or technological values) and social values by reflecting on the impact of cars, smoking, TV, desk on society. Chosun was partly excited and partly wondered by her deeper thinking about the influences of science and technology in her daily life. She formed a habit of analyzing a thing or a phenomenon deeper in terms of the influences of science and technology. Throughout the study, Chosun talked about what she was learning in this study with her mother, and they sometimes did collaborative reflection on STS issues together.

Chosun was a very lucky child because her parents were good carers for her growth. Her mother did not work and, thus, spent many hours with her daughter. To Chosun's mother, Chosun was more like a best friend. They especially liked talking to each other and encouraging each other's work—Chosun's mother was learning at a community learning centre. Chosun's mother grew up in a very similar patriarchal family environment to Sora's mother in which she was not allowed to go to a university mainly because she was a woman. A space of talking to each other became another reflective space of learning and helping who they are and what they will do for each other's growth.

On November 25, she reflected on the relationships between fictions and the development of science and technology in her STS journal.

> Sara Finally came to cool the Hot Blast of Harry Potter
>
> The above title was on today's newspaper. I thought to myself, 'How wonderful a story Sara [Sara is another science fiction.] would be?' 'How come it could excel the fame of Harry Potter?' At the moment, however, I neglected and just closed it [newspaper]. But I am rethinking about it now and came to know that those fictions also are due to the development of science and technology. That's because there would be no writers who wrote Harry Potter and Sara, if we had no development of science and technology. The power of science and technology made it possible for the

> writers to write fictions. In old times, a writer imagining flying in the sky and cars would be recognized as a great person of imagination. But those kinds of things have become just common things today because of the development of science and technology. As was in the past, now new things are emerging because of the new science and technology. Some time those new things will be common things. But today's writers write things in our dreams. People can imagine more and more things and make their dreams come true out of those fictions. Even if, things cannot be realized, it is just good because we can enjoy our imagination. The more magical stories emerge, the more changes are found in children's interests and topics in newspapers and movies. Like this, science and technology is closely related to our lives. (STS Journal, 11/25/2003)

This time, Chosun looks into both sides of value influences between scientific values (or technological values) and social values. She writes about Harry Potter and Sara, two characters in the above mentioned fictions. First, she says that the writers' imaginations told in these stories are also influenced by the development of science and technology. She says that people's imagination of flying in the sky and cars in the past has become common sense now. Second, she says that many parts of people's imaginations in today's world will be accomplished in the future, but it enables us to be creative and work for the imaginations. She expands her ideas into other areas such as newspaper and movies by saying "the more the stories of imagination are created, the more changes are found in children's interests, topics in newspapers and movies." By this, she means that people in society are not merely influenced by science and technology but try to create their imaginations of science and technology. She describes these constant interactive influences of social values and science or technology in a real sense.

On December 6, she further develops her reflective capacity into the dimension of social phenomenon. She reflected as follows:

> Private Institute

> Frankly speaking, it is quite hard to go to the private institutes for me. Parents force their children to study more and more in order for them to survive the competitive world as the economy grows. Private institutes are the ones among the choices given to parents. But if private institutes don't meet children's expectations, or if children think that going to private institutes is just a routine, or if children simply 'drive their bags' [carry their bags], it is no use at all. But parents always want their children to learn at private institutes, even though they may spend for nothing. Having lots of stress from going to private institutes, or spending for nothing is due to the negative aspects of the development of science and technology, if we think deeper. That's partly because children have to learn more to live in a more competitive world which are due to the development of science and technology and partly because schools cannot provide all the necessary education needed. That is why private institutes emerge. When good private institutes open, parents try their best to have their children enrolled to educate them better. I think people should try their best to educate well in schools so that children may stay at home and parents save money. (STS Journal, 12/6/2003)

In the above narrative, Chosun chose private institute as a topic but expanded her narrative into a more complex social critique. First, she sees a few problems of going to private institutes, particularly, children's and parents' stress and spending much money. However, she attributes the problems of going to private institutes to the competitive world and the problems of school education. She again attributes the competitive world to the development of science and technology. People are described as struggling characters between their internal and external conditions. She recognizes the problems of private education as a more structural problem which are related to improper school system, competitive world economy system, and the development of science and technology rather than people's lack of capacity.

On December 21, she worked on a more dynamic STS issue that happened among her friends. Chosun went to a music room with two other friends. Music rooms are very popular among Korean elementary children, and they usually enjoy singing Korean popular songs. While singing in a music room, a bad incident happened. When one of her friends said, "I hope I can find 'Mansu's song.' [This song is a bad language song in which Mansu, the character, in Mansu's song is made fun of.] The problem arose because 'Mansu' in the song was the nickname of the other friend. The other friend was very upset and yelled at her friend by using some bad words. Chosun was very hurt with her friends' serious arguments and she reflected as follows:

> These happenings were actually possible through the development of science and technology. That's because the development of science and technology changed the world we live in, by creating music rooms, thus, creating new bad words, and thus, creating bad language songs. My friend irritated the other friend by using the bad language song to make things more fun. The other friend took it so seriously and finally led herself to use bad language… (STS Journal, 12/21/2003)

Chosun was quite perplexed with this incident because she sometimes saw that the irritated friend often made fun of others by using bad language too in everyday life. But, here, the irritated friend yelled at the other friend by using bad language because she was made fun of. Chosun continued to write as follows:

> These things happen and people tend to see themselves as 'the Only Princess' because the world has changed. Some children become so selfish because they are treated too well [by their parents]. Indeed, it is surprising to see how a simple invention or discovery can make a big change in human's personalities…(STS Journal, 12/21/2003)

Chosun's reflective growth was quite amazing to Jinju and me. When we had our final interview at a restaurant on December 30, 2003, Chosun told me the secret she had struggled with during the study. Becoming a diplomat was her original dream which she had carried for three years, but she said she would change her dream into becoming a professor. The major struggle she had was because she imagined what she would do if she becomes a diplomat. She said if she becomes a diplomat, she might have to do some bad things because she had to follow her government policies even if she does not like those policies such as war related policies. She also talked about her concerns with her mother a few times and her mother recommended her to become a professor because professors can live on their beliefs. However, Chosun also said that she would become a great diplomat who contributes her life to world peace. Chosun inquired into who she is, who she was, who she will be, and she also reflected on what she does, what she did, and what she will do by moving between her internal conditions and existential conditions and by moving among the present, the past, and the future. Her dream of becoming a diplomat may be under major change or may not as she adds other experiences in her life journey. I noticed everything seemed more uncertain to Chosun, despite her intensive efforts to define who she will be during this study. However, I believe that STS journal writing provided her with a reflective space of knowing and transforming her moral identity in a more meaningful way. I also feel confident she will continue to build her dream in right ways in a reflective space of being with her best friend, her mother.

Looking into the Meanings of Technology in Children's Lives (11/12/2003-1/7/2004)

As time moved on to the later stage, I became more and more interested in what technology means to each child's life and how technology works in each child's life. Jinju's wonder is similar to mine, but she became more interested in how children cope with their STS issues while working with STS reflective activities. As a result, we observed all the 15 children's daily lives in our focus group. I have already shown Sora's and Chosun's stories in the former chapter and I hereby show three other children's stories.

I Live with a Small Blackboard: Seri's Story (12/24/2003)

Seri was a very frank and outspoken student who constantly enjoys sharing her stories. Seri's daily life was tightly scheduled according to her parents' movement patterns. She lived with her parents, elder brother and her maternal aunt. Seri's father was running a small business and his office was three blocks away from her apartment complex, and her maternal aunt was working for him. Seri's mother worked at S-Mart (pseudonym) like Wall Mart in front of her apartment complex. Her mother worked in shifts at a fish market in S-Mart either from 10:00 to 17:00 on the three days or from 14:00 to 24:00 on the four days during a week. Seri went to a private institute where she restudied all the subjects she learned at school to improve her academic achievements at school. She studied for two hours on every Monday and Tuesday and for three hours on every other weekday. She also learned three private lessons at home from private instructors: Korean, English, and Chinese. When all her private studies were done, it was time either her mother or her father and her maternal aunt arrived at home. However, she almost always stayed in her classroom for about 1 or 2 hours more after the regular class with some other close friends. They usually played oriental chess, did some games, or enjoyed talking to each other or to her homeroom teacher. That was one way of escaping her stress of learning at the private institute even if she was constantly reprimanded by her mother because of her absence at the private institute.

I hereby present Seri's stories in two ways: observation and interview. Both the observation and the interview show how sensitive she became to and how she lived with her technologies in her daily life. I observed her daily life outside of the school (Interview, 12/24/2003). I brought my personal journal and camera to document her practices.

During the observation, she addressed many of her practices of using technology whenever she passed a place of her memory in relation to technology. We had a pretty long but nice walk to the several places she frequently visited in her daily life. We followed the natural way of her body movement: school, S-Mart, her house, father's office, a convenience store, a big children's shopping store, private institute, and finally her house again. These places are all within 600 square meters.

As soon as we went outside of the school, she led me to the shortcut in the vacant lot. The shortcut led us to a two lane street where she usually crossed the street illegally to get to her house fast. She said she was sorry for not using a crosswalk because of its distance. Actually, the crosswalk was a little far away from the spot we were standing. Nevertheless, she said she became more watchful of the passing cars when crossing the street because of this study. We crossed the street by using a crosswalk anyway. While walking toward a corner, she pointed to the two signals which were out of order. Then, she talked about her bad experiences while walking on 'heel-less shoes.' Heel-less shoe has a small roller on the back part of each sole so that children can enjoy sliding on downward hills while walking. Seri had a few small injuries from using heel-less shoes. She said using heel-less shoes is very dangerous and gave me the three reasons of the danger: the raised sill between a road and a pedestrian (In Korea, the sills are quite higher than the ones in Canada), the big slopes of pedestrians and roads (We have many mountains and hills even in inner city), and cars parked both alongside and across pedestrians (Pedestrians are sometimes occupied by cars because of the limited parking spaces). She remembered that the sellers of heel-less shoes told her that using those shoes were good for her health in order to sell them, and she criticized that the sellers did not teach her how to use those shoes in safe ways. However, she said she did not use heel-less shoes anymore for safety through reflection in this study. (STS Issues Meeting, 12/10/2003)

As soon as we turned the corner, we saw a huge S-Mart. As we walked alongside of its front gate, she remembered her memories about her mother and told me the stories because her mother was working in S-Mart at the moment we passed by. She reflected as follows:

> My mom sometimes came home with a cut on her finger. Sometimes it is because of fish bones and sometimes it is because of a knife. She buys a bandage, but you would know it becomes swollen in summer. So, I feel really sorry for my mom. I feel really sorry… She tries her best for us and earns money. My father does for us too. But I frequently try not to go to the private institute. (Conversation, 12/24/2003)

Seri felt so distressed whenever she saw the incident that her mother came home with a cut on her finger. Even if Seri respected her mother's economic devotion to her family by working at S-Mart, she was the same child who is eager to be cared for by her mother more. She was oftentimes stressed with her mom's working at S-Mart. She said her mom's working at S-Mart made her life irregular. By this, she meant that she wished her mother to take care of her much more at home.

On the way to her father's office, an embarrassing happening occurred in front of us when we saw many advertisement cards scattered along the road which contained almost naked women in them. Those were the advertisements of adults' phone sex chatting. We became embarrassed because both of us were walking looking down. It seemed that she made an uncomfortable smile to avoid the situation. But we could not escape the uncomfortable situation because we saw more advertisement cards scattered all along the road. I took up my courage and broke the silence. I asked her how she felt when she saw these advertisements and she replied without hesitation.

> *Seri:* I once saw a spam mail [adults' sex website mail] delivered to my friend and everyone in the classroom made fun of my friend by saying 'you are a sexual pervert.' [It happened when she stayed with her close friends in her classroom after class.] Anyway, it is strange that people don't care about others who receive [those emails] and only care about making money and selling their bodies… That is just for making money and there is nothing good for them either at all.
>
> *Researcher:* How do you think it affects your life then?
>
> *Seri:* If men see those things, they will become sexual perverts. And a mentally strange person… I heard from my mom that she once saw a drunken person dancing naked in front of a restaurant… (Conversation, 12/24/2003)

It is interesting that she assumed that men were the buyers of sex and women were the opposite. From this incident, I came to know that how much technology had helped the values of women's body to be degraded into merchandise by immoral socio-cultural structures, affecting children's moral growth negatively. When walking over a mild slope, she pointed to her father's office. I asked "Do you often go to your father's office?" and she continued to tell her story as follows:

> *Seri:* I don't go often, but sometimes I go there.
>
> *Researcher:* Do you like the space?

> *Seri:* I like that space. It's fun to do the computer there. But there is no television… TV was an issue among our family. [Whether they should buy a TV in her father's office or not] But I thought that my father would come home late. He might see a soccer game or news there. So, I suggested that we should not buy a TV. It might disturb my father while he was in the middle of work.
>
> *Researcher:* What made you think that way?
>
> *Seri:* I thought this idea while learning science and technology lessons. [TV was one of the most frequent topics of technological misuses among the children.] (Conversation, 12/24/2003)

At the moment, I was really encouraged by her saying and thought to myself 'How decent a girl she is!' The signpost in front of her father's office also reminded me of the telephone number of sub-quality food (junk food) sale report she mentioned at our STS issues meeting (11/25/2003). At the meeting, she said she had a mind of reporting the bad practices of sub-quality food sale to the authority concerned because she once had had a serious stomach trouble from them. Across the street was a convenience store Seri sometimes went to with her friends. She enjoyed buying chewing gum and chips by using her pocket money at the store. She particularly liked eating instant bowl noodles by filling hot water in the bowl with her friends at the store during the intervals of her hectic going from one study to another. However, she said she easily lost her appetite for her dinner because of the snack she ate at the store.

The next spot was 'Morning Glory,' a big children's shopping store, which houses children's books, beauty accessories, stationery, bags, celebration confectionary, etc. She liked going shopping to the store with her close friends mostly during the weekend. This place was another place in which we could not use a crosswalk simply because it was too far to reach it. What she usually did in this store was eye-shopping because she was short of money to buy the accessories or the purse she wished to have at the store. However, she said she became happy when special days were coming because her purse got easily full money enough to buy things at the store. She said she usually bought chocolates, Pepero (long chocolate sticks), candies, carnations, and many other items in the store to give presents to her friends, her teacher, or her parents to celebrate the special days throughout the whole year. The most important special days were Valentine Day, White Day, Pepero Day, Choco Day, Candy Day, Parents Day, Teacher's Day, and Christmas. Some of the special days such as Pepero Day, Choco Day, and Candy Day were intentionally initiated by food industry to gain profits from selling their products. Despite their commercial purposes, I came to know that these regular events were providing children with a happy accent to their busy and hard work both inside and outside school.

Next, we went to her private institute. We had to use an elevator to 6th floor on which her private institute was located. When I entered the institute, I felt perplexed with all the compartmentalized rooms and the inside was pretty dark. There were about 20 small rooms and each room could house about 15 students. In a room, I saw a blackboard, a small desk, and a chair for a teacher, and I also saw six long tables and chairs for students. In this room, she was forced to relearn what she had already learned in school for about three hours every weekday. She said she chose the private institute because she had become jealous of her brother's earlier learning at the institute. But she said she was considering withdrawing from the institute and learning English instead partly because there were no close friends studying together at the institute and partly because Sora, her competitor in class, gave up learning at all subjects institute a couple of months ago and was currently learning English only.

On our way to Seri's home, she pointed to the landfill she chose as a problem spot in her participatory inquiry into technologies in her community because it produced bad smells. She also said that she was particularly overburdened with her private lessons at home because she had to prepare many things in order to take one lesson. When we were passing by the street she crossed illegally to get to her school, she said:

> If I were the President of Korea, I would build many overhead pedestrian bridges. If there were more bridges, people wouldn't cross the street illegally anywhere. And if people sold lost things such as cell phones, I would double the penalty. You know people sell lost cell phones. Last month, I picked up a lost cell phone in a public bathroom and I gave it to the front desk. But the person at the front desk didn't even try to broadcast it such as 'We picked up a lost cell phone.' I hope anyone who lost it come to the desk.' I felt somewhat annoyed. That's because the person [at the desk] didn't care for the person who lost it. He must have thought that the person [who lost the cell phone] would come. (Conversation, 12/24/2003)

In her narrative, she criticizes Korean social and cultural structures. By referring to overhead pedestrian bridges and the lost cell phone, she sees that a wrong socio-cultural structure causes people's immoral behaviour and becoming moral people, in a sense, depends on good socio-cultural structure.

We finally arrived at her home. There were a few things I wanted to observe in her house. Most of all, I asked how she was cooking instant noodles. She talked about her bad use of cooking noodles in STS issues meeting (11/25/2003, 12/3/2003). She said she often had the hot water with the noodle overflowing on the gas stove, which often caused a sudden big fire—In Korea, gas comes out from the gas emission holes on gas stove and when hot water drops on the gas, it causes a bigger fire. She used to cook and eat noodles because it was a very easy snack which could fill her hungry stomach before her parents came home in the late evening. Jinju advised her to use a little bigger pot, to put the pot on the farthest gas stove, and to use a scoop when she put the noodles into a bowl instead of holding the pot in order not to burn her body. She showed a big pot and showed me the way she was cooking after Jinju's advice. She had made many efforts to use her technologies in right ways to make her life better at home. She stopped teasing her mother to buy her a kickboard for which she had yarned for almost a year (STS Journal, 12/8/2003). She wore long clothes and started to play in safe places such as within her apartment complex (STS Journal, 12/8/2003). She was not quite successful, but she also had done moderate efforts to have a balanced diet (STS issues meeting, (11/25/2003, 12/3/2003, 12/10/2003). She also said she did not buy sub-quality food outside anymore. She told a funny story that her father was sometimes scolded by her mother because the plants in her terrace were withering because of his smoking—A terrace in Korean apartment is blocked by big windows both from outside and from inside. She talked about her using computer, TV, books, and she also talked how a little technology of her photo album meant to her. She recognized almost all living items and the meanings in those items as part of technology.

Seri has a precious technology at her home. It is a small blackboard. Seri has been holding a dream of becoming a teacher since her kindergarten year because she was so much attracted to the way her kindergarten teacher taught her class. It was when I asked whether she had anything special at home that she talked about her blackboard in her classroom as follows:

> *Seri:* I have a blackboard in my home. That. (She points to the blackboard in class.) My mom bought me one because I scribbled so much on my desk. As you know, teachers at private institutes use it a lot when they teach us as teachers do in school too. It seemed fun to use chalk. It seemed fun to teach children.
>
> *Researcher:* How did you buy chalk?

> *Seri:* You can buy chalk in any stationery near here. I bought it there, and it was a great fun.
>
> *Researcher:* Where did you buy the board then?
>
> *Seri:* My mom bought it for me at World Stationery [former name of 'Morning Glory']. I speak the same things I learn from my teachers in my private institute or in school.
>
> *Researcher:* That sounds very interesting. (Researcher gave a big laugh.)
>
> *Seri:* Yes. It is a lot of fun.
>
> *Researcher:* Do you have someone who listens to you?
>
> *Seri:* (After a pause), if I had listeners, that child wouldn't listen to me. Then things become boring. When I have no one to listen to me, it is just like that I chat to myself. So, it is more fun. (Final Interview, 12/24/2003)

When going shopping with her mother about 3 years ago, a small blackboard caught her eye. She kept after her mother to buy it for a few weeks and finally made it. She has a routine since she bought the blackboard. After class, she runs to the blackboard, picks up chalk, and explains what she learned in class to the imagined students by writing and drawing something on it. She told me that just before the final exam, she drew some triangles, rectangles, and trapezoids, and explained how to measure the right angles and widths of them. She explained, "I am sometimes reprimanded by my mom because of the chalk debris left on the floor. But, by this blackboard, I always feel happy and want to study more and more." She fixed her blackboard several times and one time she readjusted it on another wall by using a hammer. When I asked, "Why don't you buy a whiteboard then, you won't have such debris dropped on the floor," she responded with a mild smile, "Well! Then, I have to use markers, but I don't want to buy that. I wouldn't feel like I am a teacher! I should feel like I am a real teacher. I am old enough not to scribble with markers."

Perhaps, it was her aesthetic attraction experienced with her kindergarten teacher which moved her to live with her dream of becoming a teacher through the small blackboard. Seri responds aesthetically to the experience by writing or drawing something on the blackboard for 3 years while imagining becoming a good teacher. It must be noted that her aesthetic response with the blackboard leads to her existential effort toward becoming a good teacher by using reason in a desirable way, which ultimately enables her to grow intelligently, emotionally, aesthetically, volitionally, and morally in many places of her daily life. The above example suggests that growing and strengthening children's aesthetic experiences can contribute to children's intellectual, emotional, volitional, and moral growth. Thus, aesthetic dimension should not be left as an area of uncertainty or a dimension to be controlled by rational judgment or duties of virtue.

I asked, "Is there something you wish the most?" Without hesitation, she replied, "My first wish is world peace because our family can live a happy life in world peace." When I asked how she had a wish of world peace, she said, "I got scared when I saw news about wars long time before and that's why…" Then, she related it to her another future dream which came from this study. She said that she also wanted to become a doctor for her parents because she might cure her parents' diseases in the future. I cautiously asked, "Are your parents sick?" She replied:

> *Seri:* No. They are not. Just when they get old… Once I counted my mom's age when I become 20. Then I found her age becomes about 60s or 70s something. So, I become so worried about my mom.

> *Researcher:* You wrote about death a few times before...
>
> *Seri:* When you see news, you see people in a war. Besides, I think 'How was this world made? And I will die soon.' When countries have bad relationships [She was talking about North Korea's threat.] or when countries go on a war. [She was talking about War in Iraq.] When I hear the sound of fighters, I start to run and become scared… Bin Laden collapsed Twin Towers in the United States and many people died from it. I see so many incidents like those… (Interview,12/24/2003)

She talked about news on wars on TV in many times during the study. I presumed that she may have seen those kinds of news on TV so many times because wars in Iraq and North Korea's nuclear threat were frequent headlines on Korean news in the first half year of 2003. Seri's concern about war and death is situated in her letter to Sadako Sasaki too. She drew a picture and wrote her reflection as follows:

Figure 9. *Seri's letter to Sadako Sasaki*

> To Sadako Sasaki:
>
> Hello? I am Seri going to Peace Elementary School. I often think about something! Do people feel pain, if they go on wars? What kind of pain would it be? Where can I

> escape from dying, if a war breaks up? These wonders make me think much. I think much that if I die, I hope I die with my mom… I think much about how many days I would live from now on. Sadako Sasaki! Do you wish for a peace too? I wish for a peace when I sometimes watch TV. I don't know why people must fight… I envy you Sadako Sasaki. That's because you went to heaven in an easy way. I hope I would die without much pain if I die from a war. I have fought many times with my friends… with Sora too. With the children in my group…(Children's Work, 11/10/2003)

After the interview, I became sad with the reality that how adults' misuse of science and technology drove a small child into a horror with the sound of a flying jet fighter and into worries with death. Is it not adults' job to grow and strengthen children's hope for their life? However, Seri was a decent child in that she also related her reflection to her friend, Sora. Sora lived next door to her apartment. Sora excelled her in almost every subject, and Seri became so jealous of Sora's excellence, which easily led to a psychological conflict with Sora. Jinju and I saw Seri's frequent reflections on her struggle with Sora on her lips, from her body movement, and in her diary and STS journal in order to get more attention from her teacher, and I also saw her subsequent regret for her wrongdoings of hatred, argument, and jealousy while studying in a variety of reflective spaces throughout the whole study. Seri confessed to me, "Sora is a real good friend. I know… All bad things happen because of my jealousy of her." (Conversation, 12/10/2003)

Franklin (1992) pointed out that understanding technology requires us to put "technology in context because context is what matters the most" (p. 15). As we find our life meanings through experience with people and in contexts, technology also takes on life meanings through experience with people and in contexts. As we have seen in Seri's stories, there were a wide range of meanings of technology in her daily life. Morning Glory, heel-less shoes, the private institute, the crosswalk, the raised sills, the advertisement cards of sex phone chatting, and the small gift of chocolate for her male friend were all part of her existential conditions of technology Seri was living with, and all of them had meanings in Seri's life. Some of the technologies worked as a more creating force such as the small blackboard and Morning Glory while some of them worked as a more alienating force such as news on TV and the advertisement cards of sex phone chatting. Some of them played both roles of creation and alienation such as S-Mart which stole the hours of being with her mother from Seri while it provided her with a moderate economic support for her study at her private institute as well as for her pocket money. Franklin (1992) warned that people who see technology as mainly the application of scientific knowledge to real-life needs and problems can underestimate the real meanings of technology in human experience. She saw that technology is a multifaceted entity which includes activities, a body of knowledge, structure, and the act of structuring. By this, she meant that technology is not the simple sum of invented material components but a powerful cultural system which can constrain, prescribe, and alienate human activities. Through a date with Seri, I found how diverse ways technology worked in Seri's life and how much Seri understood technology as diverse cultural entities with which she constantly created meanings by scribbling on a small blackboard, negotiated life meanings through letting her mom to work at a fish market, and struggled with learning at the all subjects institute.

However, I saw how much she became sensitive to the negative aspects of technology and how much she acquired her existential capacity to cope with her existential conditions of science and technology by listening to the changes she told during the date. An important point I raise here is that the negative aspects of technology in Seri's life can be turned into meaningful ones and the positive aspects of technology can be more meaningful in Seri's. I believe the secret heavily depends on both Seri's moral capacity to cope with her existential conditions of science and technology. I also believe that providing a reflective space of working with their own STS issues is a good way of growing and strengthening the capacity.

I Live with a Computer: Dolshei's Story (11/12/2003)

Dolsehi was a tall good looking male child whose dream was to become a professional gamer. Dolshei lived with his father, a younger brother, and his grandmother. It was in the first lesson, 'Brainstorming,' that I became interested in his life because he related some negative aspects of science and technology to social problems such as bombs and wars even if he could not extend his ideas further into a more reasoned standpoint when I asked, "Why do you think bombs and wars are social problems?" Dolshei was a very curious child who was very interested in this study. His journal writing was full of his devotion to learning about science and technology. He cut many newspaper clips, printed helpful web pages, and wrote reflections on them. He oftentimes came to me and asked his wonders about science. He also frequently came to his homeroom teacher, Jinju, and tried to check whether Jinju read his journal writing.

It was a couple of weeks later that I asked Jinju to tell me more about Dolshei. Jinju said:

> Dolshei is living in a difficult environment because his parents divorced a few years ago. Dolshei has been making efforts to do better [study hard], but he becomes easily discouraged when he gets test results. I don't feel good when Dolshei is discouraged by the test scores [he gets]. (Conversation, 10/01/2003)

I could tell that he would live in a rather harsh family condition from his appearance because he was carrying dirt on his neck, wearing same clothes, and yellowish runny nose. I felt a strong sympathy for his life conditions because I also lived a similar life to Dolshei's when I was about his age. That sympathy moved me to explore how technologies are situated in Dolshei's life and how they work for him. Jinju and I discussed it with Dolshei and his father and were successful in achieving consent forms from them.

However, I had to face a difficulty on the day of our observation. During the lunch time, Dolshei asked me whether I would spend the whole afternoon with him. When I said I would want to if he allowed me, his face turned out to be worrisome, and he left with a little hesitation to the science room in which he had to clean the room—Korean students have to clean their classroom, the attached aisle, and some designated areas in school. After that, I had waited for him about two hours for my after school observation. To our disappointment, he never happened to appear in our classroom. Jinju and I called his house several times, but there was no answer. I had no choice but to give up my observation by thinking that 'he may have forgotten our observation schedule.' However, when I was driving my car outside of the school, I noticed him walking with a few friends. I stopped and asked whether he forgot our after school observation schedule. He said, "No" with a little concern. Then, an idea hit upon to my mind. 'Oh my gosh! What did I do?' 'He must be afraid of showing his house.' 'How thoughtless was I?' I asked him whether it would be OK to interview him for a while in a nice restaurant instead of observing him. He seemed to like my idea and we had a nice conversation at a restaurant near the school. After a while of encouragement, I asked:

> *Researcher:* How do you spend after school?
>
> *Dolshei:* I play with my computer and watch TV and study and then sleep after having dinner.
>
> *Researcher:* What do you usually do with your computer?

> *Dolshei:* I do games. Seal Online Game…
>
> *Researcher:* What is it?
>
> *Dolshei:* It was made by Say [Internet website name]. I do games which are for 11 years old. Characters are funny. Monsters are funny and exciting.
>
> *Researcher:* How do you play that game?
>
> *Dolshei:* I kill monsters and upgrade my level. For other games, if I kill monsters, I can see something like blood coming out of those monsters. But for this game, I can only hear some voices [cry] and they disappear. (Interview, 11/12/2003)

In his narrative, it was clear that he tries to show me that he is not doing violent games for which I cannot confirm. Dolshei believed he was addicted to overusing his computer. Dolshei normally spent over four hours per day during the weekdays and 6 hours per day during the weekends for games. He said he sometimes felt dizzy and felt like throwing up. However, he felt excited when he sat in front of his computer. It seemed natural for him to love his computer. Once going for his work in the morning, his father came back home as early as 7: 30 a.m. and as late as 3: 00 a.m. from his workplace. His grandmother worked from 6: 00 a.m. up to 6 p.m. He said he liked his grandmother because she cooked for him and his brother. However, it seemed that he needed more than that. I asked, "Isn't there anything you wish to do when you see other students?" and he replied:

> *Dolshei:* Yes. I sometimes think about that…
>
> *Researcher:* Where do you want to go the most?
>
> *Dolshei:* Everland [The biggest fun park in Korea].
>
> *Researcher:* You may want to go to Funland [The biggest fun park in his city].

> *Dolshei:* I went to Funland almost everyday when I was with my grandfather. [He is talking about his good life before his parents divorced or before his grandfather passed away.] (Interview, 11/12/2003)

He continued to say that he envied the children who go on a trip on weekends the most and wished to learn playing harmonica, taking taekwondo lessons, and learn English at a private institutes, but he could not learn them probably because of economic difficulty. But I could not ask more because I was afraid that he might be hurt. I feel hurt whenever I remember the stories he said to me not because he could not go on a trip or learn what he wanted to learn but because a computer seemed to be the only exit of his harsh living conditions. He must have had no choice but to play with a computer in order to seek happiness. I am still imagining his face smiling in front of that little machine. I have had a great difficulty with my question of 'how can I interpret this computer which seems to bring about happiness for him?' However, it must be also true that the computer would work as an alienating force against him in the long run.

However, he did an excellent job in changing his habit of overusing his computer because of Jinju's caring. Jinju once talked to me and said:

> I actually knew that he was having a hard time in the two minds. I mean one was that he did make efforts to be excellent in school and the other was that he experienced failure because of the low scores he got after test. I knew that, but I think I neglected his life… (Her face turned serious). I feel sorry for him. I feel really sorry… So… I want to do something for him from now on. (Regular Meeting, 11/15/2003)

We shared a common understanding that reducing computer time alone would not be meaningful, but replacing it with other possible activities would work it out. Jinju said Dolshei liked reading quite well. So, we decided to take him to the school library located just beneath his classroom and find some good science books for him. Jinju took him about twice per week for about a month and spared her time with Dolshei to encourage him to be more interested in reading. Dolshei was interested in reading science books, particularly biology books. Jinju was happy with Dolshei reading books during recess and lunch time. He borrowed books regularly and took them to his home to read. Jinju checked Dolshei's progress about a couple of times per week and Dolshei was very much encouraged with Jinju's special care. It was about three weeks after Jinju started her special care for him that I asked Dolshei how he was doing with his readings and he confidently replied, "Yes. I am doing well" (Conversation, 12/3/2003). He said he continued to read books and spend little time in doing his computer. As a result, Dolshei wrote 10 reflections on his reading science books and three reflections on his reducing computer time in his STS journal. However, Jinju and I could not pay much attention to Dolshei after mid December because of our busy schedule of observations for other children.

At the final interview, I asked how he was doing with his computer:

Dolshei: I now spend about an hour during the weekdays and an hour and a half during the weekends.

Researcher: How much time did you spend before?

Dolshei: About 4 hours during the weekdays and 6 hours during the weekends.

Researcher: What do you usually do with the remaining time?

Dolshei: I read books, and take care of my brother.

Researcher: What books do you read?

Dolshei: I read books about plants and animals.

Researcher: How do you take care of your brother?

Dolshei: I play with him and cook together.

Researcher: How do you feel about the changes you have made?

Dolshei: I feel really good.

Researcher: How?

Dolshei: When I used my computer so much, I felt a serious headache, but I rarely have headache now. And I couldn't concentrate well, but now I can concentrate well. (Interview, 12/27/2003)

On the last school day on December, 31, I personally met Dolshei at the restaurant I had interviewed him again. This time, I met him not because of learning something by doing another interview but because of my inner desire to share my child stories part of which are written in Chapter 2. I said, "Dolshei, I have my own story which I want to share with you today." I tried to create a safe mood in which he could take my words by heart. When the mood was on the rise, I shared my stories. After listening to all the stories, he said, "I have a question for you." I said, "Yes. Tell me" and he said "Are your stories all true?" I said, "Yes, my stories are all true stories." And then we continued our conversation:

Researcher: Do you miss your mom?

Dolshei: Yes… I miss my mom so much.

Researcher: Does she contact you sometimes?

Dolshei: Yes. She does.

Researcher: If you want to help your mom and your father and your family, you should become a great person when you grow up in the future. If you live well up to your dream of becoming a great person, everything will turn out to be just so fine. Your mom, your father, and your grandmother all will be happy and be proud of you. But if you become a person who lives a bad life, they will continue to carry the pain of not caring for you until the end of their lives. So, if you love your mom, set your dream of becoming a great person and concentrate on developing your capacity to

> make that dream come true. You don't have to envy others who go on a trip weekends or who learn at private institutes. I did not go to a single private institute before I graduate my high school. But I made it. Learning in school is enough for you to be successful… (Reconstructed Quote in Researcher's Journal, 12/31/2003)

Right at the moment, he burst into tears and could not continue to say any word for a while. When I said, "I believe you can do well," he only said "Yes." I did not cry at the moment, and I still don't know how come I did not cry. After leaving the restaurant, I said, "I want to buy you something you want to have. So, allow me to buy you one" But he refused my offer by saying, "I have nothing to buy," just like I did to my friend who offered me a ride to my school on a cold day when I was 7th grade. I continued to ask him, but he refused several times. After several requests, I was able to get his consent. He said he had a book he had wished to buy. So, we went to 'Morning Glory' where I went with Seri. He seemed quite happy with it, and we shook hands and said good-bye. I saw him fading away by limping slightly with a book from the scene. He was limping probably because he suffered from a kind of disease when he was young. At the time, I finally burst into tears, and I had to go inside my car to cry. I cried and cried until my hot heart cooled down. I prayed for him, 'Have confidence in your life. Study hard and become a great person.' I do not like to use the words 'study hard.' But I knew that studying hard is the only seemingly route he has for his better life, so was mine.

I felt so sad that I could not find any meaningful technology working positively for Dolshei except for books which finally found a small niche in his harsh living conditions with the help of Jinju's special care. It was even sadder to see that Dolshei was a very energetic child who was always eager to learn more and to be successful in academic achievement tests. But his existential conditions of technology worked very negatively and sometimes drove him into a corner of helplessness especially when he got low scores in school tests. Even if his economic conditions were harsh, I know that if he had a little more caring family environment, things would be quite different. Dolshei is the child we, homeroom teachers, must provide more caring to. The children who lack caring at home have more expectations for their homeroom teacher, for their friends, for the classroom as a space of creating life meanings. When they are walking to their school, their hearts may be a little more tense by imagining themselves cared for by their homeroom teacher and by imagining their personalities, abilities, interests, and struggles cared for by their homeroom teacher. Children are constant seekers of caring and attention. With their homeroom teachers' sincere caring, they can become excellent meaning makers of their lives in a classroom, as Dolshei did with Jinju's help.

I Live with My Friend's Technologies: Mina's Story (1/7/2004)

Mina was a very small female child who always carried a smile on her face. Sunmi was a very thoughtful child who liked reading books. Their friendship began when Sunmi was transferred to Peace Elementary School just right before this study began. Both of them, however, were very sensitive and curious about things around them. They spent most of the day together in and out of school. There was a very big road between the school and these children's houses, and only three female children in the class were living across the road: Mina, Sunmi, and Bin. Once they arrived at home, it required them to spend much time and effort to go back to the other part where their school was located partly because the other part was a bit far away and partly because they needed to use a tall overhead pedestrian bridge to get to the other part. It was our STS issues meeting that I met Mina and Sunmi frequently, and they really liked to participate in this study. However, these two children's environments were quite different. Mina lived with her father, mother, and a younger brother who was only a year younger than she was. Mina's father lost his job a couple of years ago and usually stayed at home. Her mother went to a nearby factory to work at about 8 in the morning and got home at about 7 in the evening. When staying at home, Mina usually cooked, set a table for her father and younger brother, cleaned her house, and did the dishes. When I interviewed them in Sunmi's home on January 7, 2004, she described her role at home by saying, "I become a mother when I am at home completely." (Interview, 1/7/2004). Mina often went on an errand to a nearby store to buy cigarettes and liquor for her father, which was illegal in Korea. When doing an interview with these children in Sunmi's house, I asked Mina, "What do you usually do in your house except the chores you mentioned during the vacation?" She said, "I lie down and roll over here and there." This harsh family environment made Mina go to Sunmi's house and Mina spent most of her after school time in Sunmi's house. I asked them, "What do you usually do here?"

> *Sunmi:* We finished vacation homework in just three days. [In Korea, a teacher gives a scheduled homework for both summer and winter vacations.]
>
> *Researcher:* In three days?
>
> *Sunmi:* Look at there. Those are the ones finished. I wrote things in the sun. [Sun shaped coloured paper cut by scissors] As you see, those coloured papers are so small. I glued one on it [on their homework notebook] and glued 8 cosmoses [cosmos shaped coloured paper] and finished it.
>
> *Researcher:* Aren't there any other vacation homework?
>
> *Sunmi:* I went to a museum with my father and Mina. I took pictures, glued them and wrote something…
>
> *Researcher:* Where do you usually work?
>
> *Sunmi:* Here. We never go to Mina's house.

Mina: We can't go to our house because my father stays.

Researcher: (To Mina), Do you like Sunmi's house?

Mina: I can't do my homework without Sunmi at all. (Interview, 1/7/2004)

By staying in Sunmi's house, Mina could escape from her boring routines and enjoy many things with Sunmi such as doing homework, chatting, cooking, and playing games. Sunmi was also happy with being with Mina probably because Mina was the only female friend she could find nearby after school and probably because Mina followed her very well. There was Bin living near her home, but Bin was not as friendly as Mina to Sunmi. Mina's father seemed to have been so stressed with losing his job and could not have enough room in his mind to take Mina to a museum to get her homework done. Mina had to walk about 10 minutes to get to Sunmi's house, and she had to cross a busy street. The street was quite busy and cars usually ran fast. When I asked how she got to Sunmi's house, Mina said she always crossed the busy street illegally with extreme caution because a crosswalk was far away. Mina found Sunmi's house full of fun and comfort compared with her small house. Mina gave some examples such as good computer, high speed Internet, piano, wider television, wider and cleaner space, and helpful resources such as Sunmi's father and his car. Sunmi's house was the place in which Mina read about 20 science books, wrote reflections on those books, and wrote her STS journal and STS practice journal during this study. Both Mina and Sunmi got special STS reading awards from Jinju during the study.

However, Mina told me something very surprising. By using a metaphor, Mina said, "Well, Sunmi is a landlord lady and I am her maid working for her." Mina said she has a habit of cleaning Sunmi's house, doing the dishes, cooking noodles, and helping other things for

Sunmi in order to please her. However, she seemed quite happy with doing those things because she could find happiness and feel being alive with Sunmi in her house. Sunmi was a good carer for Mina. Sunmi knew how much difficulty Mina was having at her home and tried her best to help Mina to overcome her struggles with doing homework and finding fun space and friends. Working in Sunmi's house was Mina's struggle to find happiness out of her lack of meaningful technologies and caring in her house. Mina was a decent child because she was still doing her chores for her family when she got back home, but she said she could not find any meaning at home. Her father's losing his job and her mother's desperate efforts to maintain their living were all part of Mina's alienating conditions of technology, which negatively influenced Mina's life.

I had to admit that the lack of caring in Mina's house had Mina finding little meaning in the technologies in her house even though Mina had computer, TV, books, and desk. This lack of caring ultimately worked as a negative force which drove Mina to create her life meanings in the technologies in Sunmi's home in a space of being with a friend. It must be noted that technology alone barely takes on meaning in a person's life. Imagine there is a single man living alone with all kinds of advanced technologies in his luxury house, but he cannot marry a woman because of his disabled body. Suppose that what he really wants is, however, to live happily by sharing love with his nice wife. He may feel frustrated whenever he enters his luxury house full of advanced technology. All kinds of technology in his home may not provide him with life meanings. If he had a nice wife who loves him despite his disabled body, he might be happy to live as a penniless man. He would find precious meanings in seemingly useless old technologies in his shabby house.

If there had been a more sincere caring in Mina's home, Sunmi might have been invited to Mina's home and the technologies in Mina's home could have provided more life meanings to Mina. Sadly enough, all the negative existential conditions of technology in Mina's home are the ones she has to overcome for herself. No one else can ultimately lift the burdens pressing hard on her shoulders. However, Mina was lucky to have a good friend who was able to read all the difficulties and minds she was carrying on her shoulders. I know how much meaning the technologies in Sunmi's home provided for Mina because of Sunmi's full friendship through sharing computer, piano, TV, and Sunmi's father's car. Indeed, an invitation of Sunmi's full friendship meant more than anything else for Mina.

CHAPTER VII

Shared Understanding, Messages, and Future Research

Introduction

In this chapter, I summarize our shared understanding based on the research questions I stated in the Introduction. First, to explore the reflective experiences of 5th grade children as they worked on STS reflective activities, I set the following three research questions.

- What are the elementary children's experiences while working on science, technology, and society (STS) moral issues through reflective activities?
- What stories do the elementary children tell while working on science, technology, and society (STS) moral issues through reflective activities?
- What influence, if any, does the study have on the elementary children while working on science, technology, and society (STS) moral issues through reflective activities?

Second, to explore the reflective experiences of the homeroom teacher and the researcher as we worked on STS reflective activities with children, I set the following three research questions.

- What are our collaborative experiences while working on science, technology, and society (STS) moral issues through reflective activities?
- What stories do we tell while working on science, technology, and society (STS) moral issues through reflective activities?

- What influence, if any, does the study have on us while working on science, technology, and society (STS) moral issues through reflective activities?

Third, to explore how 5th grade children cope with their existential conditions of science and technology, I set the following three research questions.

- How do the elementary children cope with their existential conditions of science and technology?
- What does technology mean to the elementary children's lives?
- What stories do the elementary children tell about technology in their daily lives?

It must be noted that our shared understanding was created in a relational space of STS reflective activities where the children, Jinju, and I worked together and led a larger storied life. So, it is necessary to summarize the meanings of our collaborative narrative experiences as a teacher and as a researcher based on the cohesive themes among the situated, contextual, and particular elements of our larger storied life. Alongside, educational messages are provided for the people who are, I believe, mostly related to the created themes. Additionally possible future research topics are presented which are again followed by the researcher's final reflection.

Shared Understanding and Messages

Science and Technology are Powerful Existential Conditions/ Messages with Parents

As we have seen so far, science and technology exist as a variety of dynamic entities which can create or alienate children's lives. Sora's learning at an English private institute and Seri's small blackboard worked as creating forces which helped them to cope with their existential conditions of technology. On the contrary, technologies in Dolshei's and Mina's lives worked rather as alienating forces which frequently prevented them from creating their life meanings. To Dolshei, being with his computer provided an important space in which he could find his life meaning, so did Sunmi's house to Mina. This was the reason Dolshei played computer games and toured Internet for over four hours everyday. This was the reason Mina crossed the dangerous street illegally a few times everyday, did all kinds of house chores for Sunmi, what she called, as a 'maid.' What do Dolshei's and Mina's stories tell us? They tell us that they are struggling with their powerful existential conditions of science and technology to create their life meanings.

Why are they struggling? They are struggling with powerful existential conditions of technology because of the lack of caring in their families, which, in turn, is rooted in the negative aspects of socio-historical structures in which their parents are struggling with their harsh living conditions of technology. What do Dolshei and Mina need? What they need is someone who can really care for them, their internal and existential conditions. Their stories make me sad because Dolshei and Mina are all hardworking children who constantly seek the resources of learning. However, we saw how their lives became meaningful with Jinju's caring and Sunmi's caring. Sora and Seri's economic conditions were not much better than Dolshei and Mina, nor were their desires or abilities to learn at all. Sora constantly had to negotiate with her existential conditions of technology to create her life meanings. This was why she had to stay in her mother's small and noisy beauty shop where she had to help cooking, cleaning, and going on errands for her mother. This was why Seri said she wanted her mother to take care of her at home rather than working at a fish shop until midnight.

One thing different, however, was that there were responsible caring parents beside Sora and Seri. We saw how Gukhwa, Sora's mother, contributed to Sora's capacity to cope with her living conditions of technology by practicing good modeling as a working mother. In today's technological Korean society, women are struggling with several selves as human, woman, mother, working person, and daughter of their parents. As a teacher, I saw many female parents were struggling with playing their different roles of these selves, particularly between a mother and a working person. However, Gukhwa's story of becoming a good working mother provides many working mothers in Korea with valuable insights of how to become a better working mother. Gukhwa lives a good storied life as human, woman, mother, working person, and daughter of her parents by showing how to become a good model of one's own life, how to become an active listener to their daughters, how to nurture a person as an independent being, and how to become a responsible carer of children. I feel that Sora also learns who she will be as a better working mother from observing how Gukhwa lives. Parents' responsible caring is, indeed, the fundamental dynamic which enables children to grow and strengthen their capacity to cope with the powerful existential conditions of science and technology and, in turn, leads to creating better life meanings with science and technology.

Reflection Has Powerful Moral Capacity/ Messages with Teachers

As science and technology become more complex, pervasive, and global, so does a child's or a teacher's moral life. Moral education should be more than the indoctrination of predetermined values or the rationalization of children's value judgment. STS education should be more than teaching technical solutions of current global STS issues such as environmental problems. Both moral education and STS education need to grow and strengthen children's own experiential moral capacity to cope with the powerful existential conditions of science and technology they face in their daily lives.

I believe that children's existential moral capacity can be best achieved by growing and strengthening children's reflective capacity. In this study, first, we saw how children in a whole group reflection made sense of social and moral issues such as health issues, women's rights issues, children's rights issues, stress, violence (using bad languages), and the problems in individualized life with the three technologies such as plaything, washing machine, and private institute in 'Interview with Parents.' Second, we saw how the STS issues in children's community lives were keenly uncovered through reflection by Bomi (park), Gyungsu (crossing a street), and Nari (apartment wall) in 'Participatory Inquiry into Technologies in our Community.' Third, we saw how children in 'Cooperative Artwork' keenly formed their critical eyes on the development of science and technology and actively proposed better ideas of improvement from the plannees' point of views. Fourth, we saw how much Seri was aware of her existential conditions of technology: crossing a street, S-Mart, signals which are out of order, heel-less shoes, overhead pedestrian bridge, advertisement on adult phone sex chatting, TV in her father's office, a convenient store, a big children's shopping store, special days, private institute, the bad smell from a landfill, news on TV, small blackboard, her father's smoking, and her cooking practices. A child's life, thus, is filled with innumerable things, happenings, events, and phenomena affected by the complex, pervasive, global, and powerful science and technology (Kirman, 1997). However, children are not and should not be mere absorbers of one's existential conditions of science and technology but are and should be active meaning makers who can overcome and create better existential conditions of science and technology for themselves, which, I believe, ultimately enables them to be responsible citizens promoting the positive use of science and technology in society.

As I stated earlier in this chapter, children's capacity to cope with their STS issues fundamentally depends on parents' responsible caring. However, educators, cannot become mere spectators because we constantly see many children struggling with their powerful existential conditions of science and technology in every class. Especially, the children who lack parents' caring easily look for other persons who can care for their internal and existential conditions. The targets usually become their homeroom teacher or their friends. We saw how Byungsu struggled with his hard physical training when there was no one who would really care for his harsh conditions. We saw how Dongseo was struggling with doing his work in school, so was Dolshei. But we saw how these children find their meanings with their existential conditions of technology through Jinju's reflective guidance and genuine caring.

We saw that Jinju did not see Dolshei's life as a mere spectator but took action to grow and strengthen his capacity to cope with his bad practices of overusing computers. After listening to Dolshei's story from me after my interview with him, Jinju constantly positioned herself in the imagined now, in the imagined past and in the imagined future in order to define who she is as the teacher of Dolshei. She also positioned herself in Dolshei's whole life to find her best part for Dolshei's whole growth. It did not take Jinju more time to care for Dolshei because Jinju was already a hardworking teacher who always prepared for her teaching intensively. However, Jinju had a problem at the beginning, and it was that she tried her best to educate her children to learn things she had already set for the children. She tried to educate Dolshei to catch up with her collective expectations on school academic achievement, virtues, and even the ways Dolshei learns. Jinju thought that children should be educated based on her predetermined values, but she was not fully able to see Dolshei's internal and existential conditions: his unique personality, ability, interest, and, particularly, his existential conditions. What Dolshei desperately needed was someone who would care for all these conditions. However, after she came out of her fixed set of educational practices, she was able to see her children as they were, which enabled her to see each child as a whole being and, thus, find her best part of contribution to the growth of each child differently. As understanding changed, so did her meanings of life as a teacher. Even if her caring for Dolshei was a bit of her efforts, it made a big difference in Dolshei's life. Jinju found her part of contribution was been reliving by Dolshei. Dolshei's growth in turn became a meaningful part of Jinju's life by confirming who Jinju became to Dolshei. Indeed, their becoming a part of the other's life enabled them to have a common set, a relational mode of having between Dolshei and Jinju. At this point, it is important to distinguish who was the initiator of this relational mode of having. It was Jinju, not Dolshei. The whole story of Jinju and Dolshei was initiated by Jinju's reflection on who she is, who she was, and who she should be as Dolshei's homeroom teacher. This is why teacher is a carer and Dolshei is a cared for as Noddings (2002) pointed out. As a non-expert on science education, moral education, and social studies, Jinju was able to become a successful STS educator, moral educator, and social studies educator through her caring spirit and her paradigmatic shift of seeing a child. This is the reason I believe that the space of, what I call, 'society-based STS education' can best fit to homeroom teachers in elementary setting.

However, as we struggled with a lack of scientific knowledge in science experiment, we realized that educators who have different backgrounds may have difficulties with lack of knowledge in different areas, and, thus, they need to work closely together with other teachers who have more knowledge in the areas such as science, social studies, moral education, language arts, art and other disciplines.

Reflection Takes on Meaning with Action/ Messages with STS Scholars

Children's reflective capacity is grown and strengthened by their conscious efforts of reflection and action. After this study, the newly created themes of this research have recurred to the ideas of Dewey, learning by doing, and Friere, the praxis of reflection and action. According to Dewey (1966) and Friere (1971), the existential meaning of an individual cannot be separated from the existential meaning of one's socio-historical contexts. Existing as a human means not only knowing the self, the reality, and the world but also transforming all of those. The issues of science and technology are not technical issues but moral issues embedded in an individual's existential life in relation to one's socio-historical contexts. This, in turn, means that solving STS issues depends on an individual's existential moral capacity to know and transform the self and the socio-historical contexts which produce and reproduce the negative aspects of science and technology. Because an individual's moral capacity is the fundamental dynamic of creating one's moral selves and socio-historical contexts, it is a necessary condition for STS educators to educate children to have moral capacity to know and transform their moral selves and their socio-historical contexts together.

Bin's story comes to the fore again at this point. Bin said that she had not thought about science and technology at all before she learned from this study. She said that she just lived her life of studying, coming to school, going home again, eating, and going to her private institute as it had always been. During my writing process, I frequently recalled the moment Bin caught me when I was about to say goodbye after our final interview by saying, "Teacher, there's another thing I learned from this." She said:

> By doing these, I've come to think more. That is… There is no right answer [no single answer]. So, I had to find and write something for myself. And I wrote my feeling and think my writing again. I continue to think like this… When I think more, I think the thing I thought simply about and extend my thinking to some extent. Then, many things occur in my mind. (Interview, 12/28/2003)

Bin's reflection, however, took on deeper meaning when she worked on many aspects to transform her moral selves and her socio-historical family contexts. By reducing her TV time from five hours to 30 minutes, she came to know how she was illiterate on the negative aspects of TV. Soon, she also found herself transforming her familiar socio-historical context by building a closer relationship with her parents and her brother with her added time. She also said she was proud of what she did with reducing TV time. After completing the reflective cycling of reflection, action, and another reflection on her action, Bin's reflection finally took on powerful life meaning. She worked on other issues the same way such as having a balanced diet, not using bad languages, and helping her father's smoking. Her reflective cycling brought her meaning to the way she saw a person too. She said that she hated Japanese people without any reason before this study. However, after reflecting on Sadako Sasaki's innocence and genuine passion for world peace, she said that she was trying to see a person in positive way first. Indeed, Bin's reflection took on meaning through the dialogical mode of reflection and action.

However, as I worked on STS studies to understand the fundamental dynamics of the misuse of science and technology, I constantly had to face a difficulty in finding the related literature. Because society is the fundamental cause of the misuse of science and technology, it is important to study the internal dynamics of the misuse of science and technology in society. However, most STS studies scholars seem to have concentrated on critiquing the epistemological aspects of science. We saw how seriously children expressed their hopes for the brighter future science and technology in Video Clip on Cattle Dung Beetles and in Sadako Sasaki's story. We saw how much Chosun was genuinely concerned about the impact of immoral socio-historical structure on the misuse of science and technology based on her humanistic values which she learned from the sad story of Sadasko Sasaki. As a scientist, Sokal (2001, p. 25) suggested, STS studies practitioners need to work on "a more serious task of the social, economic, and political understanding of science and technology" which frequently prevents scientist from doing fair social practices in science for human progress. Children's stories also tell us that scientists and technologists should be fully aware of the powerful immoral external values coming from society and their social responsibility of doing science and engineering for the better lives of our precious children. As Simpson (1967) warned us, all of us, politicians, business people, scientists, technologists, and common people should be aware that technological advancement alone cannot help human beings to progress biologically and culturally.

As I worked on STS education, I have also found that current STS educational practices of teaching STS issues are based on more, what I call, science-technology based approach in which they focus on the influences (or impacts) of science and technology on society rather than the influences (or impacts) of society on science and technology. I have also not found any distinct approach in the area of social studies or moral education which is different from science education even if STS issues are clearly social and moral issues and society is the fundamental dynamics of the misuse of science and technology. STS educators need to be aware 1) that the fundamental causes of STS issues lie in the immoral socio-historical structures, 2) that STS problems will continue to reoccur without curing the social problems as diseases reoccur without curing the original cause, and 3) that STS issues affect human beings as a dynamic entity such as powerful cultural or structural system or as individual's experiential or existential conditions. As a result, STS educators, especially in the area of social studies and moral education, need to work more on growing and strengthening children's experiential capacity to cope with their own existential conditions of science and technology in broadened socio-historical contexts by overcoming the boundaries of the subject based curriculum (Yager, 1995; Marker, 1993), and the misconception of science (Osborne, 2000).

Each Child Should Live One's Own Unique Moral Life/Messages with Moral Educators

In Nobel's biography, some children evaluated Nobel's life more as a common person while others evaluated his life more as a whole scientist and technologist. Some felt Nobel's life more personally while others felt his life as a more social matter. In Sadako Sasaki's story, Miok read this story more in an aesthetical way, Dalai, Chosun and Chulsu read this story more in intellectual ways, and Eunhee and Bin read this story more emotional ways. In science fiction, Dongseo described his story with a robot more as a personal struggle while Sangsu described his story with same sex marriage, cyber human, and scientists' struggles more as social struggles. Despite all the differences, we can see that their moral viewpoints are not only all reasonable but also capable because those moral viewpoints are made from their own reflective experiences. Their stories also tell us that educators can grow and strengthen children's moral capacities not only based on their different personality, ability, interest, and prior knowledge but also based on their own reflective experiences with people, contexts, and interactions in different places.

Emotion, aesthetics, will, and reason are all unique and important moral capacities, and they also help children to grow their reflective capacity interchangeably and inseparably. Some children have more emotional capability than others while some have more rational capacity than others. Some children have more aesthetic capability than others while others have more volitional capacity. For example, Somi is a very emotional and aesthetic child. Somi's aesthetic and emotional experiences by watching cattle dung beetles led her to make a rational judgment that cattle dung beetles always help us, and they have no reason to die. Then, her judgment drove her to create her internal will of becoming a veterinarian to live her life by caring for sick animals. Living with a dream of becoming a veterinarian is also another valuable emotional and aesthetic experience which will lead to a more fruitful experience for Somi. The dialogical cycling of emotional, aesthetic, rational, and volitional reflection all helped Somi to grow her reflective capacity interchangeably and inseparably. Living with her full capacity of aesthetics and emotion is Somi's unique way of living. With those fruitful aesthetic and emotional experiences, Somi can live better with her own life meanings beautifully.

As another example, Chosun is very rational and volitional child. Chosun's emotional and aesthetic experience of Sadako Sasaki's story led her to think about what had really happened to Sadako Sasaki because the story was a kind of shock to her former belief that Japanese are ill-natured people, her concept of which, I believe, had been formed by steady indoctrination from education. Then, she made a rational judgment that Sadako Sasaki was the real victim of the negative aspects of science and technology because of her innocence and her genuine spirit toward world peace. This incident drove Chosun to analyze the socio-structural issues of science and technology and how they affect people through reflection on such topics as private institutes, genetic engineering, music room, smoking, cars, TV, and fiction based on her genuine humanity. You may remember that Chosun's analysis of the socio-structural aspects of science and technology positioned herself in a struggle with her serious ontological question of whether she has to become a diplomat because diplomats have to follow their own government's directions. However, she made another rational and volitional moral choice that if she becomes a diplomat, she would become a person who contributes to world peace. Defining what she should do as a diplomat is also another valuable rational and volitional experience. The dialogical cycling of rational, volitional, emotional, and aesthetical reflection all helped Chosun to grow her reflective capacity interchangeably and inseparably. Living with her full capacity of rationality and internal will is Chosun's unique way of living. With those fruitful rational and volitional experiences, Chosun can live better with her own life meanings beautifully.

We saw that these children have their unique internal conditions: their unique personalities, abilities, interests, and moral viewpoints. We also saw that they have their unique existential conditions such as unique people, places, and phenomena with which they interact. Each of these children created their own desirable life meanings and constructed their own desirable moral selves and existential conditions to cope with their lives through Jinju's caring reflective guidance. After this study, Jinju and I came to know that each child has one's own moral capacity and responsibility to construct one's meaningful moral lives based on their uniqueness and that educators' roles in moral education are to provide caring and reflective guidance to grow and strengthen children's moral capacity to cope with life based on all of their humanity and capabilities as Dewey believed (1938, 1966).

As a curriculum subject, moral education in Korea has traditionally focused on character education. Even if character education has played a great role of educating moral people, moral educators in Korea need to reconsider the scope, content, and teaching strategies of moral education as a curriculum subject. In today's fast growing technological world, it is even more important than ever for teachers to grow and strengthen children's experiential moral capacity by which children autonomously make sense of their powerful STS existential conditions, create right moral decisions, and take right actions in their daily lives based on their personalities, abilities, interests, and social settings.

Place of Humanistic Values in Children's Reflection/ Messages with Peace and Global Educators

Throughout our human history, people's moral values have shaped and have been shaped by their powerful socio-historical structures. We see how many wars and conflicts have erupted from the ideological aspects of community values such as nationalism, religion, racism, imperialism, ethnic groups, and interest groups. We also see how innumerable people have suffered from losing their rights of living happy storied lives on earth from the wars and the conflicts because of these community values. Community values are our essential values by which we live with belonging, love, and care. However, as Noddings (2002) pointed out, we need to be watchful of the dark sides of community values in the age of globalization and technology because they have possible ideological characteristics which can inflict valuable human experiences. This is the reason I believe we, educators, need to enable children to live with others harmoniously as global citizens based on the essential humanistic values such human dignity, dialogue, and respect and caring for (the self, others, and nature).

Korea suffered from losing over 5 million people during the Korean War in 1950s because of the ideological conflict between socialism and capitalism. Korea also suffered twice from Japanese imperialist invasions. However, it is not desirable for adult Koreans to force children to inherit their hatred toward Japan. Even if we should bring our painful lessons from Japanese imperialism, I believe it is more desirable to enable children to dialogue with Japanese people to overcome their adults' painful memories and to create better relationships for children's better lives in the future, which, I believe, will also contribute to children's creation of more desirable national values. This was the reason Jinju and I used Sadako Sasaki's story. Sora, Chosun, Bin, and many other children in Jinju's class hated Japanese before the study. I still remember Sora's desperate effort to avoid listening to the Japanese girl's story. However, we saw how these children changed their attitudes dramatically. Bin went further to say that Japanese common people who killed Koreans were also the victims of the misleading Japanese government, and she even felt sympathy for them. Chosun went further to say that the government which started a war is not killed, but it forces innocent people to pay for war by suffering. However, it is very interesting that Sora, Chosun, and Bin all became more watchful of the immoral Japanese socio-historical structures which led innocent people to go on a war while they increasingly saw Japanese common people as the victims. As a result, I presume that they have formed more critical eyes on the possible Japanese nationalism which may mislead their people into a war in the future. When they face a situation of a possible war, their moral viewpoints can become a footstep by which they reflect on the moral issues of the future war, and their reflection may bring about their efforts to avoid the war from the common people's point of views.

While Jinju was working with Sadako Sasaki's story, she did not make any moral judgment on Sadako Sasaki's life. All the children constructed their desirable humanistic and critical moral values from their experiences based on their personality, ability, interest, and prior knowledge. What we did was to provide a reflective space for children to develop their moral capacity to live with others in an age of globalization and technology, which, I believe, can help them to prevent any forceful ideology from alienating their valuable human experience.

I believe this reflective activity, as part of peace education is very useful when it is used in every country to enable children to form common people's points of views on their existential conditions of science and technology. Thus, educators in peace education and global education may consider an international movement of using the stories of humanistic values to help our children to be equipped with more capacities to live with people in other countries, religions, and ethnic groups in the age of globalization and technology.

Trust, Negotiation, Ethics, and Sharing Authority in Collaborative Research/ Messages with Researchers

Our collaborative reflective space provided both Jinju and me with more meaningful results through promoting each other's reflective practices. Kittkamp and Osterman (1993) explained, "Reflective practice is neither solitary nor a relaxed meditative process, but reflective practice is a challenging, demanding, and often trying process that is most successful as a collaborative effort" (p. 19).

As they explained, our collaborative journey was a challenging, demanding, and trying process. I remember myself entering Jinju's class with hope and enjoying the bright faces of all the children. However, as I stated earlier, we soon had to face each other's difficulties particularly in finding a space for me and in struggling with the discontinuity for Jinju.

However, Jinju went through a serious reflection on who she was, who she had been and who she would be as a teacher partly because of the two incidents and partly because of her observations of Bin, Hana, Dongseo, and Gyungsu—she did not find good academic abilities from these children before this study. Jinju shared her reflection:

> Before this study, I tried to drive children's thinking to a set of fixed ideas. I wished that. Children were felt meaningful [by me] when they did that way. But we had them write their own thinking, and I found children are all different and unique, and I also found myself starting to see children individually. Then, I found myself looking forward to expecting how this child would think on this topic… (Interview, 12/30/2003)

Even if the study did not go as I wanted during October, I did not push her to open her inner and outer space because it was not ethical to cause concerns to my cooperating teacher. Upon my reflection, it was my patience which opened her space. We were successful in building trust in this way, and the trust became the cornerstone which enabled us to share each other's authority.

Jinju made major contributions to this study in several ways especially since November. First, she provided me with deeper insights into children, contexts, and their interactions. Second, Jinju initiated most of the STS reflective activities at a later stage and maintained this study as an expert. Third, Jinju's greatest contribution to this study was her suggestions on using STS practice journal and doing observations on children's lives outside the classroom. As you may notice, children's action on their reflection provided this study with meaning. Without her contribution to STS practice journal, I could hardly imagine the significance of this study. Without observing children's daily lives outside of the classroom, I could not be able to know how children interact with their existential conditions of technology.

However, I did not fully negotiate my role of observer and my space in her class, which led both Jinju and I to a struggle in October. I learned the valuable lesson that both a teacher and a researcher should fully address and negotiate each other's purposes, roles, and ethics before they engage in a collaborative research (Clandinin and Connelly, 1988). Thus, researchers who engage in collaborative research need to be aware of whether they build trust, negotiate each other's purposes, roles, and ethics, and whether they share each other's authority so that both of them participate in research as experts. As always true with a collaborative research, working with a different teacher would have created different STS reflective activities, which would subsequently lead to different ontological and epistemological experiences for all of the participants: children, their homeroom teacher and me as a researcher.

Ideas for Future Research

Gender Difference in Children's Moral Lives

During the whole process of this study, I had to face a constant struggle with the questions of "Does male and female children's moral growth have different paths?" and "Are their different growth due to sex difference or gender difference?" I expressed this issue a few times in this study. On the one hand, it was noticeable that male children led discussions and writings more in a justice perspective—rational or hypothetical value judgment (Gilligan and Attanucci, 1988) than female children did. They were particularly active when they engaged in judging Nobel's life, imagining future science and technology in science fiction writing, and asking Dr. Min questions on genetic engineering. However, I am not sure that the insights of male children's discussions and writing are deeper than female children in terms of rational and hypothetical value judgment because of the wide range of individual differences. On the other hand, it was noticeable that female children led discussions and writings more in a caring perspective—emotional or real life value judgment (Gilligan and Attanucci, 1988) than male students did. They were particularly active in writing letters and poems to Sadako Sasaki, expressing their ideas of interviewing their parents.

Another interesting phenomenon was that many children made sense that technology contributed to the betterment of women in one way or another. This was mainly because they reflected on many of their real life STS issues by comparing the past life and the present life.

Korean society is characterized by its strong cultural legacy of male-domination, and there seem to be a variety of technological existential conditions which helped in shaping or reinforcing different moral roles as females and males. For example, female children liked reading Internet fictions and going shopping while male children liked going to a game room or a PC room where they enjoy playing games, sometimes, violent games. Therefore, I suggest the following future research topics: 1) Do female and male children interact differently with their existential conditions of technology? and 2) Do children's existential conditions of technology affect female and male children's moral growths differently?

Media in Children's Moral Lives

Media was a vital part of children's existential conditions of technology in this study. First, Seri's life was influenced by media to a great extent. She often reflected on death because of her watching TV, particularly, the news on wars and North Korea's nuclear threat. Many children liked reading Internet fiction and chatting in virtual community. Many children also said they learned bad languages from these sources. I also saw several male children using their computers over four hours per day during the weekdays and more than 5 hours per day during the weekends. In using their computer, they often enjoyed hitting and killing people. Besides, all of the children in Jinju's class expressed their negative experiences in virtual community such as adults' websites, curses, bad languages, or adults' advertisement emails. Therefore, it can be a future research topic could involve the experiences of children's interactions with media.

Reflection and Children's Cognitive Thinking Skills

Even if children's cognitive thinking skill was not a major part of this study, both Jinju and I found a great interest in the changes children made with their thinking skills. First, children generally seemed to have formed a habit of reflective thinking and many of the children led to self-reflective practices. Jinju said that she found a great difference in children's thinking skills because they told and wrote their thinking more actively and freely in every class (Regular Meeting, 11/20/2003).

Bin wrote, 'Science and technology develop' in her pre-study questionnaire. When I asked, "How do science and technology develop?" she needed quite a while to answer, "In good ways." (Conversation, 9/23/2003). When I asked for some examples, she could not answer. Even if Bin had an abstract concept, I presume that it was her spontaneous concept because she could not elaborate it to conscious concrete concepts. However, I saw Bin had formed her conscious concepts, and she said her growth of thinking skills came from this study (See Becoming a Reflective Child in Chapter 4). I presume that children's reflection with their real life experiences based on their needs and wants will probably contribute to the improvement of children's cognitive thinking skills more than children's reflections with more hypothetical lessons. But I could not elaborate it mainly because data in this study was not systematically gathered for this purpose. Therefore, it may be a future research topic to explore or test how children's reflections on their real life lessons based on their wants and needs contribute to the improvement of children's cognitive thinking skills.

Attending from and Going forward

My journey of working with STS reflective activities has been a narrative experience of struggling with the tensions between my theoretical paradigm and human experience. On the one side, I brought my theoretical paradigm that children need to know and transform not only their selves but also the immoral socio-historical structures of science and technology critically based on reflection and humanistic values. On the other side, I brought my belief that children must construct their own values on their own. But my understanding of how to use my theoretical paradigm to grow and strengthen human experience was weak at the time I entered the field. So, I had to bring the unsolved tensions into my research field with my negotiated decision that I must not indoctrinate my theoretical values to the children and Jinju. However, through this study, I confirmed that children have the ability and humanity to grow their desirable moral selves in relation to their socio-historical contexts through reflection as Dewey (1966) and Friere (1971) believed.

Interestingly, the tensions were overcome with the help of Jinju and her students. First, Chosun's writing on 'Sara Finally Came to Cool the Hot Blast of Harry Potter' grew and strengthened my understanding on the meanings of human experience (See STS Journal in Chapter 5). In her writing, she positions human experience as a dynamic entity which not only is shaped by one's existential conditions of science and technology but also shapes those conditions. She positions an individual as the protagonist of creating the life meanings of science and technology in human history. Through my constant reflection on Chosun's writing, I found my concept of society-based STS education model was rather static even though this model situated science and technology in socio-historical context. Thus, her writing provided me with an insight that I, as a STS and moral educator, should position each child as the protagonist in STS education and moral education so that each child can grow and strengthen one's desirable moral values from one's daily experiences, not far away from one's real life (Dewey, 1938, 1966).

Seri's reflective growth grew and strengthened my understanding of human experience in another way. When Seri and I had a date on her observation day, I saw many socio-historical structures constraining her life in diverse ways. We happened to see the phone sex advertisement cards because adults continue to put those cards on the windshields of the cars parked on streets. Who can deny that the dark sides of capitalism are responsible for the negative influences of the sex trade technology on children's lives? Seri was sometimes horrified by watching news on wars in Iraq, terror, and North Korea's nuclear threats. Who can deny that the dark sides of nationalism or religion are responsible for it? This is why Seri reflected on death, became horrified with the sound of a jet fighter, and came to be concerned with her parents' deaths even if her parents were healthy. As I stated earlier in the previous chapter, Seri critically reflected on other social or cultural issues with overhead pedestrian bridges, lost cell phone, the bad smell of the landfill in her community, and losing her time with her mother because of money. I saw the issues of wars, terror, international politics, and other seemingly big social and cultural issues were not far away from Seri's everyday life experience, and the issues were part of her experiential struggle with her existential conditions of science and technology. My reflection on Seri's reflective growth in her language and body provided me with a confirmation that I, as a STS and moral educator, should position each child as the protagonist in STS education and moral education so that each child can grow and strengthen one's existential capacity to know and transform not only one's moral selves but also the socio-historical contexts she or he is situated in one's daily lives through reflection and humanistic values as Dewey (1938, 1966) and Friere (1971) envisioned.

By observing all the children's desirable moral growth based on their unique capacities, I reached an understanding that my theoretical paradigm should exist to grow and strengthen children's human experience based on their unique personality, ability, interest, and social setting. This is how I overcame the tensions between my view of human experience and my theoretical paradigm in a meaningful way even if my reality is always incomplete and changing over time. In this way, I was able to reconceptualize reflection in this study as an individual's narrative experience of knowing and transforming one's moral selves and one's existential conditions of science and technology based on humanistic values. I know that this shared understanding, however, is not a simple end but a footstep of my "experiential continuum" (Dewey, p. 33, 1938) by which I will retell and relive my life.

My journey of working with STS reflective activities has also been a narrative experience of struggling with the tensions between my teacher identity of students and my teacher identity in the professional landscape. It was a serious tension indeed because I remember my struggle with the two teacher identities when I was an elementary homeroom teacher in Korea, and I cannot let the struggle happen again when I return to Korea. In the middle of my busy work in Korea, I imagined myself at camping site in a Provincial Park near Jasper in Canada. I can see a lingering tone of sunshine even at midnight in summer. The night sky looks more beautiful when it is framed by tall spruce trees. Across the sky, I can see a clear cloudy galaxy. Above all, I become amazed with the innumerable number of stars twinkling beautifully. When looking more closely, I find every single star has its own unique size, character, and beauty. With another closer look, I become surprised by the dynamic movements of meteors coming from one place and another. I cannot help but be overwhelmed by the creative art of the universe, which makes me sit on a wooden bench looking into the sky until the stars fade away into the daybreak.

Children seem to be the same as stars. They shampoo their hair, cut pencils, and pack things up. At last, children stand in front of the big mirror to check whether they are finally ready to hit the road. When they are carrying their bags on a cold day, they are also carrying in their minds of imagining themselves being recognized, praised, and cared for by their homeroom teacher. In the middle of imagining, their hearts soon start to pound a little, and they forget their cold hands. Especially, the children who either lack of caring from home like Dolshei and Mina or the children who do not have someone to take care of them after school like Bin, Byungsu, Gyungsu, Dongseo have more expectations for their homeroom teacher, their friends, and the classroom. I remember how much I felt moved when Jinju saw these children, whom she once recognized as low academic achievers, twinkling with their own beauty and character as stars do in the sky after she built a meaningful mode of working with all of these children.

Children's reflections in this study were possible because of Jinju's caring, openness, interest, encouragement, and feedback on each child's growth. Children were moved to reflect when they felt that Jinju respected and cared for their thinking, feeling, writing, drawing, language, and body movement. Such feeling of being cared for was the fundamental dynamic of enabling children's reflection, action, and meaning. Both Jinju and I received 21 voluntary thank you letters from the children during the study. They wrote personal letters, wrote in their STS journals, wrote on a slip of papers, or wrote postcards. When we were sharing their genuine thank you letters, Jinju and I were touched and came to understand why we should live as teachers. I have not noticed how much those emotional and aesthetic feelings came to my mind naturally and were reliving in my life as powerful meanings. I know that the larger meaningful story we built came from our shared meanings, and the shared meanings were built from Jinju's conscious reflection on who she is, who she was, and who she will be, which ultimately enabled her to see a child as a whole being.

I also learned that we need to be attentive to our social structures, particularly school landscape in order to understand a child as a whole person and to contribute to the moral growth of each child. At the final interview (12/30/2003), Jinju said that becoming a homeroom teacher in Korea was a very hard work for her. She explained that she had to confront many challenging issues such as fixed curriculum, fixed moral education practices, large class size, excessive teaching hours (34 periods per week/one period is 40 minute), excessive managerial work and school activities, rote learning practices, and test-oriented teaching practices. I saw how powerfully her school landscape isolated Jinju from seeing her students as whole beings. By witnessing all the meanings that erupted after Jinju's paradigmatic shift, I came to understand that knowing and transforming this alienating school landscape is an important part of reclaiming the essential meaning of becoming a teacher. Jinju continued to reflect on and ask herself who she is, who she was, and what she should do as a teacher of her students and as a teacher in her professional landscape. Her continuous reflective cycling of reflection, action, and reflection on her action led her to become successful in reclaiming the original meaning of becoming a good teacher.

Gukhwa, Sora's mother, challenged my position as a teacher in such a way that I, as an educator, should be a responsible carer for every child I will meet, especially, the children who are struggling with their negative existential conditions because they are the ones who really need a teacher's care.

Jinju and Gukhwa's life stories taught me that whatever difficult existential conditions I may have, I should find my best part to contribute to every child's moral growth. I also know that my reflective consciousness at this moment is not only a conscious process of knowing how to care for my future children but also a conscious process of knowing how to reclaim the essential meaning of who I am as a human as well as a teacher. The moral responsibility and effort to reclaim the meaning of being a good teacher will continue to ask me to reflect on my internal and existential conditions with uncertainty. I am happy to know that the responsibility and the effort is my share which no one else can ultimately lift up from my shoulders. Indeed, this research has made me feel confident with my returning journey to Korea and became a strong footstep of living a good storied life with my future children as a Korean teacher.

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APPENDICES

Appendix 1: Pre-Study Questionnaire

★ This questionnaire was made to know how you think science and technology and construct educational activities based on your understanding. Please write what you know as frankly as you can.

Name: ______________________________

Question 1: When you think about science and technology, what words do occur to you? You can write invisible things or concepts too. Please circle the words which can be used in negative ways.

____

____

____

Question 2: Write things (visible or invisible) which are related to science and technology in your everyday life.

____

____

____

Question 3: Write the images, feelings, or thoughts when you hear about science and technology in full sentences?

1) ______________________________

2) ______________________________

3) ______________________________

Question 4: Have you thought whether you are using science and technology in a right or wrong way? (Circle Yes or No) Yes_____ No_____

If you have, would you explain it?

____

____

Question 5: Have you thought whether adults are using science and technology in a right or wrong way? (Circle Yes or No) Yes_____ No_____

If you have, would you explain it?

Question 6: How do you think science and technology has changed our lives?

Question 7: Why do you think science and technology are important to our lives?

Question 8: How do you hope science and technology to be developed in the future?

Appendix 2: Post-Study Questionnaire

★ This questionnaire was made to know how you think science and technology after science and technology lessons. Please write what you know as frankly as you can.

Name: ______________________________

Question 1: When you think about science and technology, what words do occur to you? You can write invisible things or concepts too. Please circle the words which can be used in wrong ways.

____

____

____

Question 2: Write things (visible or invisible) which are related to science and technology in your everyday life.

____

____

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Question 3: Write the images, feelings, or thoughts when you hear about science and technology in full sentences?

____

____

____

Question 4: You have practiced your reflections on how to use science and technology right ways through STS journal and STS practice journal. 1) Write the changes you have made if you have, and 2) Write how you would want to make your better life out of the changes.

____

____

Question 5: You've probably had opportunities to think whether adults (politicians, business people, parents etc.) are using or developing science and technology in good ways through news, newspapers, books or simple observations of how adults do. Would you choose two stories (one for bad example, one for good example) among them and explain them?

Question 6: How do you think science and technology has changed our lives?

1)

2)

3)

4)

Question 7: How do you hope science and technology to be developed in the future?

Question 8: There were many reflective activities done in your class. They are 1) Brainstorming, 2) Planting garlic, 3) Nobel's biography, 4) Interview with parents, 5) Watching a video clip on dung beetles, 6) Listening to Sadako Sasaki's story, 7) Inquiry into our technologies in our community, 8) Interview with Dr. Min, 9) Science fiction writing, 10) Our ideal community (cooperative artwork), 11) Netiquette, 12) STS Journal Writing, 13) STS Practice Journal Writing, 14) STS reading corner, 15) Teacher's feedback on your journal. Choose the three most meaningful reflective activities among these reflective activities and tell us why?

____

____

____

Question 9: What is the biggest change you've made from this study?

____

____

____

(10-13) Choose and circle one choice among the five options.

Because of this science and technology lessons,

Question 10: I have become interested in how science and technology are used in right ways for me, humans, and nature.

Strongly agree Agree Undecided Disagree Strongly disagree

11. I make efforts to use science and technology in right ways in my daily life.

Strongly agree Agree Undecided Disagree Strongly disagree

12. This study has made me use science and technology in right ways for me, others, and nature.

Strongly agree Agree Undecided Disagree Strongly disagree

Appendix 3: Research Time Table

Stage 1: Curriculum Planning and Organization (8/20-9/22/2003)

- Teacher Consent Form (8/20)
- School Consent Form (9/5)
- Pre-Study Questionnaire (9/6)

Stage 2: STS Reflective Activities (9/23-12/30/2003)

- Brainstorming (9/23)
- Planting Garlic (9/30-12/30)
- Interview with Parents (10/16)
- Video Clip on Cattle Dung Beetle (10/23)
- Sadako Sasaki's Story (11/10)
- Participatory Inquiry into Technologies in our Community (11/22, 12/16)
- Interview with a Life Scientist (12/13)
- Science Fiction Writing (12/16)
- Cooperative Artwork: Our Ideal Community (12/27)
- Nobel's Biography (9/23-12/29)
- STS Practice Journal (11/28-12/24)
- STS Journal: Chosun's Story (9/22-12/26)

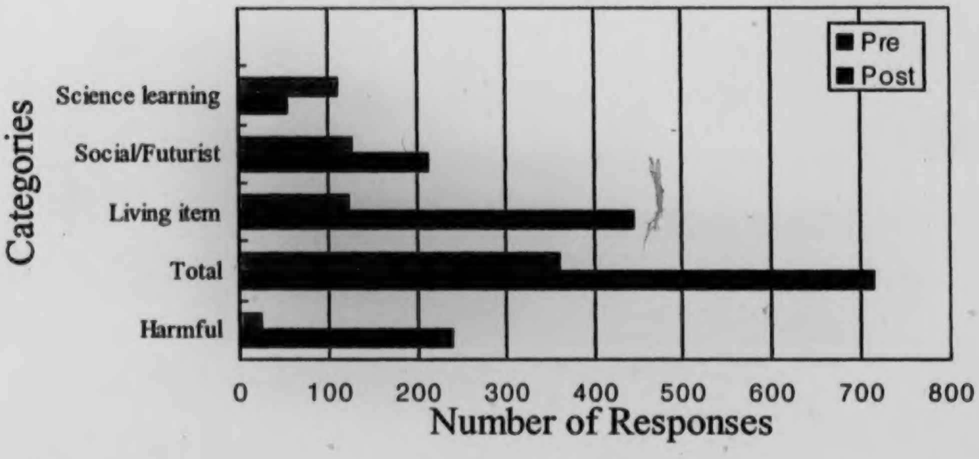
Stage 3: Observation on Children's Lives (11/12/2003-1/7/2004)

- Seri's Life (12/24/2003)
- Dolshei's Life (11/12/2003)
- Mina's Life (1/7/2004)

Stage 4: Final Interview and Curriculum Evaluation

- Students' Final Interview (12/27, 29, 30/2003)
- Teacher's Final Interview (12/30/2003)
- Post-study Questionnaire (12/30/2003)

Appendix 4: Comparison of Children's Concepts of Science and Technology between Pre-and Post-Study Questionnaires



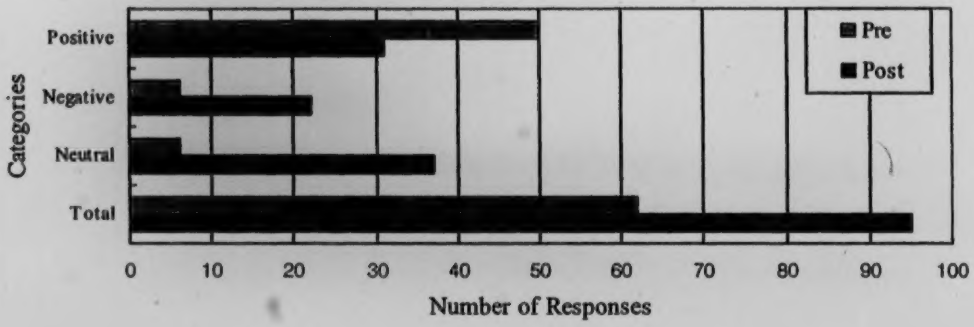
Note.

1. The number of children's responses does not stand for the number of children.
2. 'Harmful' does not stand for any of the three categories.

Brief Discussion

In post-study questionnaire, children's orientation has moved to living items and social dimensions to a great extent. The most noticeable facts are the increase in the total number of children's responses (200%, 764/360) and the increase in children's responses that can be used in negative ways (956%, 239/25). Interestingly, the living items that can be used in negative ways have a wider variety of words from a small chalk to sub-quality food than the ones in pre-study questionnaire. Some of the other examples are computer, air conditioner, kickboard, cell phone, cars, credit card, visual phone, camera, garbage etc. There is also a wider range of words that can be used in wrong ways in the category of Social/Futurist in post-study questionnaire. The examples are currency, genetic engineering, cloning technology, fighters, bad languages, hidden camera, internet, nuclear wastes, satellite, and drugs.

Appendix 5: Comparison of Children's Images of Science and Technology between Pre-and Post-Study Questionnaires

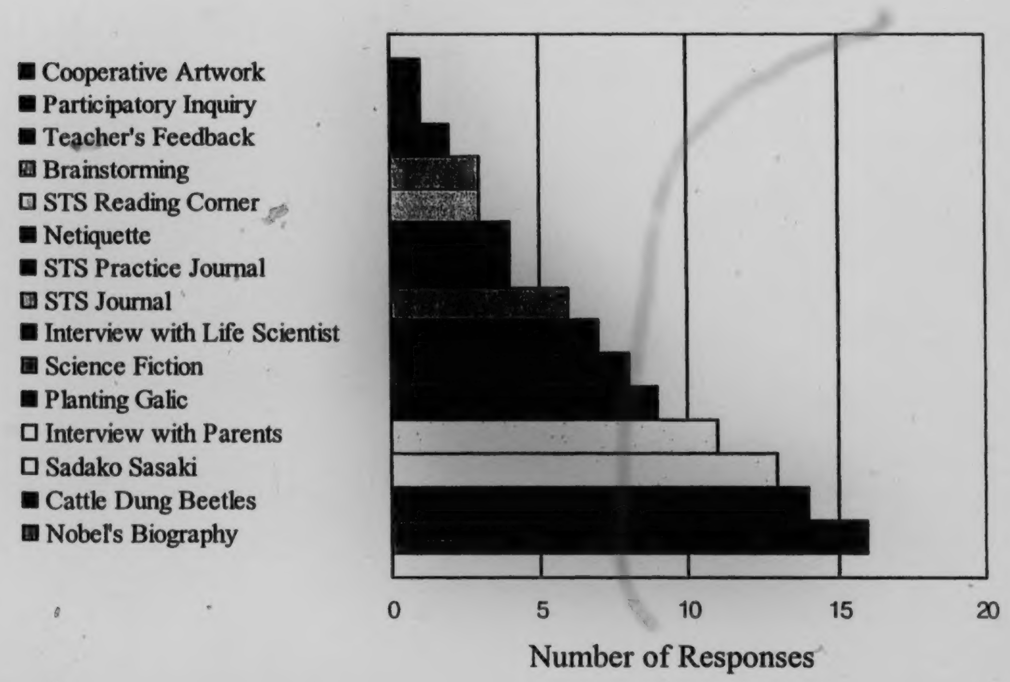


Note. The number of children's responses does not stand for the number of children. In pre-study question, each child wrote one, two, or three responses. In post-study questionnaire, each child wrote about two or three responses to this question.

Brief Discussion

After the study, children's images of science and technology have changed to a great extent. In terms of the total number of children's responses, there is about 146% increase (95/62) between pre and post-study questionnaires. As shown above, there are 366% increase (22/6) in Negative and 616% increase (37/6) in Neutral while there is 167% (50/31) decrease in Positive. This indicates that children made sense of science and technology more in negative ways and far more in balanced ways after this study. While children's images of science and technology have moved from Positive to Negative or Neutral, the variation of children's responses in post-study questionnaire is greater than the one in all of the three categories in pre-study questionnaire. Interestingly, children's responses in post-study questionnaire are more diverse in that they express a variety of questions, wonders, concerns, hopes, feelings, interpretations, analyses, personal experiences, imaginations, and visions on science and technology.

Appendix 6: Results of Children's Best Meaningful Activities



Note. The above results are based on the Question 8 in post-study questionnaire, and each child made three choices as their best meaningful STS reflective activities.

It is very hard to reduce children's individual experiences of learning from each reflective activity meaningfully by using numbers. However, there is an insight found from this question. Based on the fact that the top four meaningful STS reflective activities are all storytelling, we can presume that children like storytelling activities, particularly listening to others' stories. Nobel's biography and Sadako Sasaki's story are read by Jinju's storytelling. The story of cattle dung beetles was told by the narrator in the video clip. Children listened to a life scientist's story during their interview with Dr. Min. They also listened to their parents' old time stories at home. It tells us that storytelling is a very useful method of teaching reflective activity.

Appendix 7: Comparison of Children's Hopes for Future Science and Technology between Pre-and Post-Study Questionnaire

Question 8 in pre and Question 7 in post-study Questionnaire (Common Question)

How do you hope science and technology to be developed in the future?

Table 9. *Summary of Children' Hopes for Future Science and Technology*

Student	Pre-Study Questionnaire	Student	Post-Study Questionnaire
Bin (F)	**I hope** There are things good for our health.	1(F)	**I hope** I can see cars with no pollution, human's longevity, a panacea which cure incurable diseases.
Sora (F)	I live more comfortably and study at home in cyber space rather than at school.	2(F)	Robots help human's difficult jobs and live with humans together.
3(F)	S & T care for environment.	3(F)	We build cities in the sea and explore space because of the limited space on earth.
Seri (F)	There is a bed on which we sleep on foot.	4(F)	People don't use good technologies in bad ways, study at home as well as at school, and benefit from robots.
Somi (F)	We can do things like on TV or in movies.	5(F)	Animals speak some time and special facilities are built for orphans in which they live comfortable life.
Eunhee (F)	There are new things developed.	6(F)	People do not resemble their parents' appearance alike except blood, despite the development of life science.
7(F)	There are a) robots which do homework and chores for me and b) cars flying in the sky.	7(F)	Our country become more peaceful and provide comforts to us with the development of S & T.
8(F)	There are robots, flying cars, cars and motorbikes fuelled by air.	8(F)	S & T restore dead creature into life and produce flying cars and carpets.
Dalai (F)	I live more comfortably and lively.	9(F)	S & T preserve our nature and produce harmless drugs and cars with no pollution such as solar energy, electricity, or water.

Note. S & T stands for science and technology

Table 9 *(continued)*

Student	Pre-Study Questionnaire	Student	Post-Study Questionnaire
10(F)	I live more comfortably.	10(F)	People don't eat pet dogs anymore and preserve and love our nature.
Nari (F)	Our country becomes famous to other countries through S & T.	11(F)	Our country becomes more comfortable and peaceful with no war.
Sunmi (F)	S & T develop more.	12(F)	S & T develop cars without pollution and organic food for both humans and nature.
Chosun (F)	S & T are useful for us by coping with environmental concerns.	13(F)	We make efforts to eradicate environmental problems because the evolution of nature depends on our environment. With this in mind, we should develop S & T for the betterment of us.
14(F)	S & T cure all diseases.	14(F)	S & T develops to recover our old nature back because it looks that our nature has been destructed too much to recover.
Mina (M)	We make spaceships.	15(M)	S & T should be developed to the right direction without any condition
16(M)	More comfortably.	16(M)	S & T aren't misused bad ways.
17(M)	S & T develop more comfortably and develop no more war technology.	17(M)	S & T develops genetic engineering but only for good things.
18(M)	There is a TV which does whatever we say.	18(M)	S & T develop without any harm to humans and nature.
19(M)	There are no damage to people and environment.	19(M)	S & T develop in friendly relation to our nature. I wish to live on other planets too.
20(M)	S & T develop more newly and easily.	20(M)	S & T provide more good and comfortable life for us and restore our nature back because it is badly damaged.
21(M)	S & T develop better.	21(M)	NO WAR
22(M)	There are more inventions and more development.	22(M)	S & T develop without any harm to nature.

Note. S & T stands for science and technology

Table 9 *(continued)*

Student	Pre-Study uestionnaire	Student	Post-Study Questionnaire
23(M)	S & T don't do any harm to environment.	23(M)	S & T develop for the betterment of all humans, living creatures, and nature.
Gyungsu (M)	There are more comfortable things.	24(M)	S & T develop to help preserving nature.
25(M)	I study at home instead of going to school.	25(M)	S & T help people to be comfortable but people should not develop them for producing weapons, bombs, or nuclear bombs.
26(M)	We fly into the sky by car.	26(M)	People don't use S & T bad ways.
Taijo (M)	We regain our environment back.	27(M)	People don't think hastily but think deeper when they develop S & T.
Dolshei (M)	We travel so fast and comfortably.	28(M)	S & T restore endangered species back to the normal.
29(M)	I see flying ships, cars, robots, and humans.	29(M)	I see cities under the sea, solar cars, and flying ships.
30(M)	S & T are not used for war but used for city development.	30(M)	S & T develops in positive way, of course. Particularly for the betterment of our home life.
31(M)	S & T develop robots which understand our language.	31(M)	S & T develop peacefully, not for the bad use.
Dongseo (M)	No knowledge	32(M)	S & T should care for environment and complement current problems.
33(M)	S & T develop comfortably and safely and are not used badly.	33(M)	S & T are used for humans' wellbeing only. I hope they are not used for the destruction of our environment.
Sangsu (M)	Robots do all kinds of work, and cities are developed under the sea.	34(M)	S & T improves human longevity and natural environment.

Note. S & T stands for science and technology

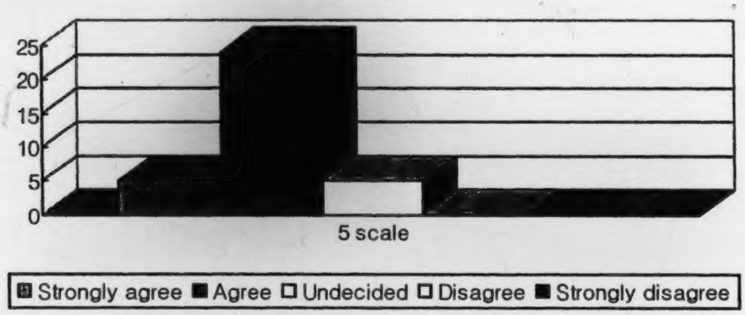
Brief Discussion

It is interesting that 28 children in post-study questionnaire express their concerns about the misuse of science and technology, particularly environmental destruction while only seven children express their concerns about the same issue in the pre-study questionnaire. Most of the other children's responses except for the 7 children in the pre-questionnaire seem to have positive views on people's practices of science and technology. However, most of the children in the post questionnaire seem to have become more sensitive to the negative aspects of science and technology.

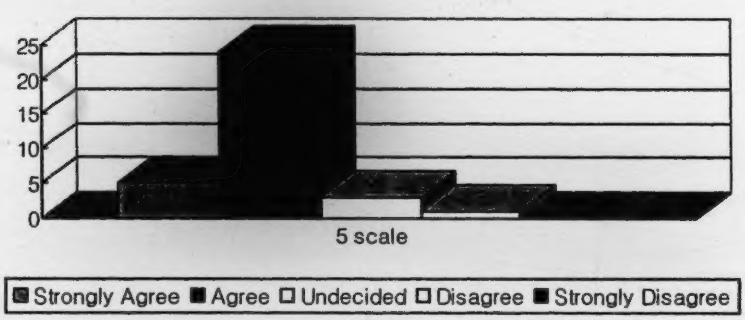
Appendix 8: Children's Attitudes to This Study in Post-Study-Questionnaire

Because of this science and technology lesson,

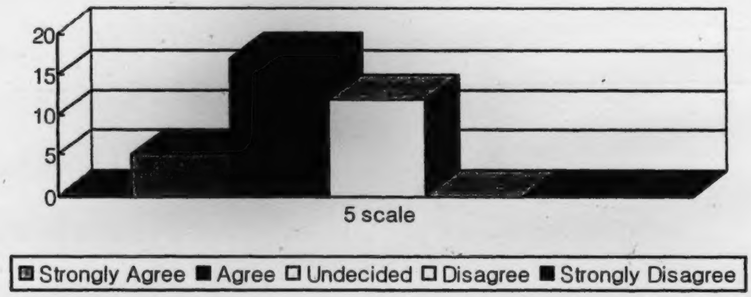
10. I have become interested in how science and technology are used in right ways for me, humans, and nature.



11. I make efforts to use science and technology in right ways in my daily life.



12. This study has made me use science and technology in right ways for me, others, and nature.



Brief Discussion

As shown above in Question 10 and 11, most of the children's responses belong to the positive side (about 85%): Strongly Agree and Agree. But 35% of the children's responses in Question 12 belong to 'Undecided.' Right after collecting children's questionnaires, Jinju and I were quite perplexed with the results of children's responses, particularly with Question 12, because we had expected higher marks in 'Strongly Agree' and 'Agree' than the real ones. After following careful analysis and reflection, I reached the conclusion that this number well represented their attitudes. First, I judged that most of the children (about 85%) became interested in how science and technology are used in right ways for me, humans, and nature because of this study. Second, I judged that most of the children (about 85%) make efforts to use science and technology in right ways in daily life because of this study. Third, I judged that about 35% of the students did not think that this study led them to use science and technology for the self, others, and nature. Interestingly, I confirmed that 3 children originally marked 'Agree' in Question 12, but they erased it and remarked 'Undecided' because they were practicing good use of technology for the self and others but not for nature (Conversation, 12/30/2003). This suggests that some of the children probably marked 'Undecided' rather than 'Agree' or 'Strongly Agree' because they found them not practicing the good use of technology for all of the three areas: self, others, and nature. As a summary, I concluded that even if most of these children have become more sensitive to STS moral issues and they make efforts to use science and technology in right ways, many of the students (about 35%) are not successful in using science technology in right ways for the self, others, and nature. Indeed, this quantitative evaluation provided us with a real helpful reflective space in which we were able to evaluate our preoccupations and see the results of this study in a third person's position.